Environmental and Engineering Programs
Materials Laboratory
Annual Report
2008

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Introduction

State Materials Laboratory Mission Statement

"Together we support our customers and enhance construction quality by providing specialized technical expertise, materials testing, and engineering services."

Welcome to our 2008 Annual Report. Our annual report was conceived as a method to convey three messages:

1. How we are measuring our performance, using internal customer performance measures
2. Informing our customers of what we do and what services we offer
3. Provide a road map to where we are headed in the future, especially with the Strategic Directions

We have expanded the Strategic Directions to provide greater detail on this important roadmap to the future. And check out the performance measures: we have driven up performance and driven down costs, especially in field exploration in the Geotechnical Division.

We appreciate any and all feedback.

On behalf of the great crew here at the State Materials Laboratory, I want to thank every customer for using our services and products in 2008; we look forward to serving you again in 2009.

Thanks,
Tom

Thomas E. Baker, P.E.
State Materials Engineer

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Strategic Directions 2007-2009

Construction Materials

Joe DeVol, Bituminous Materials Engineer

Examination of N-design: Nationwide research underway to validate the Superpave HMA design levels (compaction tables) for volumetric mix designs. The question is: are current standards giving us the best possible pavement performance?
This study to include:
• Review of WSDOT Equivalent Single Axel Loads (ESAL) and HMA design levels.
• Collect production data for comparison to mix design data.
• Identify candidate projects to evaluate pavement performance.
• Provide recommendations for future Superpave HMA design levels.
Status: Since implementation of the Superpave volumetric mix design process in 2004 the Bituminous Materials Section has been collecting test data using both the Hveem stability and Superpave HMA mix design processes on every project paved in the state. Work underway to identify previously constructed projects to use for performance evaluation to compare to mix designs at various levels. This review started in January 2005 and will continue until national standards are changed and/or WSDOT alternative identified. Mix design testing completed, working with Pavement Management Section to identify candidate projects for evaluation.

Identify and Implement New Moisture Susceptibility Procedure.
The implementation of Superpave volumetric mix design process and the phasing out of the Hveem mix design process facilitates the need for a new moisture susceptibility test procedure. This new procedure must include:
• A process to evaluate variable quantities of liquid antistrip additives.
• Use test specimens that replicate volumetric properties of HMA mix design.
Status: Surveyed other states to identify alternative moisture susceptibility test procedures. Research indicates that the Hamburg wheel tester could provide alternative moisture susceptibility test in addition to predicting rutting potential of HMA. Research proposal completed and submitted for funding. Implemented use of gyratory compacted specimens for moisture susceptibility testing until alternative can be determined.

Performance Prediction Testing (PPT) Study - Part 1 (Texas Overlay Tester). Produce gyratory compacted specimens from candidate hot mix asphalt (HMA) paving projects to send to Texas Department of Transportation for performance prediction testing. Testing includes:
• Asphalt overlay fatigue testing.
Study to provide analysis of typical HMA mixes used in Washington State in performance prediction test protocol.
Status: Samples collected from five candidate projects and shipped to TxDOT for testing. Study completed, report finalized and distributed as Technote. Results indicate significant variability in test results, no additional research with overlay tester planned.

Performance Prediction Testing (PPT) Study - Part 2 (Hamburg Wheel Tester). Research project to identify potential of Hamburg Wheel Tester to measure rutting susceptibility of HMA mixtures in Washington State. Project to include:
• Review for existing research.
• Training with TxDOT.
• Fabricate samples for testing WSDOT mixes by TxDOT.
• Develop recommendations for WSDOT to implement the Hamburg Wheel Tester.
On completion of project a report will be written and distributed with recommendation to purchase device and potential specification for design and production testing.
Status: Research and literature search completed. Working with TxDOT to identify mix design and production specification applications and coordinate on site training. Research proposal completed and submitted for funding.

Aggregate Specific Gravity Study - Part 1 (Mechanical vs. Human) Part one of this study is an evaluation of mechanical methods for the determination of coarse and fine aggregate specific gravity compared to conventional test methods. This study includes:
• Corelok automatic vacuum sealing device and the Thermolyne SSDetect testing system.
• AASHTO T84 & T85 aggregate specific gravity test methods.
Status: Testing completed report under review for final draft and distribution. No change since last reporting.

Aggregate Specific Gravity Study - Part 2 (Variation in Production) Part two of this study is an effort to measure the variability of aggregate specific gravity in quarry and gravel sources throughout production on select paving projects. This study includes:
• Identification and selection of candidate projects for evaluation.
• Scheduling and acquisition of samples.
• Testing analysis and reporting.
Status: Study was originally scheduled for 2007 construction season on four select projects but samples where not acquired as requested. Additional projects have been identified for 2008, project completion extended until 2009. All aggregate samples received and tested, data analysis underway.

Performance Graded (PG) asphalt binder (Plus Specifications). Where is the nation going and where is WSDOT going?
• What test(s) should be used to verify performance of asphalt modification.
• Work with Pavement Management to establish work plan and identify need for plus specifications.
Trial projects in Eastern Washington in 2006 season
Status: Trial project using elastic recovery test completed in the Eastern Region in 2007. Additional projects used elastic recovery test for acceptance in 2008, MSCR test data was also collected. Complete data analysis for all projects underway, draft report pending. New test and specification for 2009 delayed, waiting for new AASHTO M 320 specification due out soon. Bituminous Materials Section participating in the round robin study to evaluate the new asphalt binder low temperature bond test that uses an Asphalt Binder Cracking Device (ABCD). Device arriving 1-2 months, will report findings as completed.

Bob Briggs, Assistant Construction Materials Engineer - Administration

Develop a plan for integrated computer applications for Construction/Materials. Requirements for MATS is currently underway and expect to have an overall plan for future work to be complete by January 2007. Due to delays, this project has been extended to June 2008.
Status: Currently the SPMG group is working on ways to integrate the systems. Eastern Region has developed a system that will be used for field documentation. Mats mix design now is directly inputted into SAM. As the field testing in MATS is developed, more integration will occur with all of the materials programs.

Replace RegTec with Mats within 1 year and continue to develop the remainder of Mats. Development is underway and expect to have the first phase of deployment in January 2007 with the complete deployment of MATS by January 2008.
Status: MATS deployed phase 1 in April 07. Completed HMA Mix Design, and density standards. The rest of RegTec will be replaced by when there is a miscellaneous test report by April 2009.

Work on MTP to satisfy people's need to achieve 100% usage. The plan is to identify the problems in late 2005 and fix the problems in 2006 with 100% usage of the MTP system by January 2007. Due to delays in programming, this project has been extended to April 2008.
Status: The Eastern Region is working on a field documentation system that will require MTP to be used and kept up. With the deployment of MATS, all bid items will come from MTP and test reports will be automatically sent to MTP. A review of the users showed that only 8 PE offices out of 40 were not using MTP. We will be putting on a training class for MTP, as well as all of our computer programs in 2009. The usage is increasing due to the training that we are providing.

Acceptance and Approval of Temporary Items. Identify the temporary items that need to have approval and acceptance criteria. These will be identified in the Construction Manual. Expected to be completed in fall of 2008.
Status: We have finished working on section 9-35, temporary traffic items. This is complete.

Standardized Grout Specifications. This work involves reviewing the different group specifications and come to a standard specification that all will use.
Status: There has been a draft specification developed and is under review. This will be finished in June for the 2010 specification book printing.

System Approval of guardrail. A committee will be formed to address the DOT requirements by March 2006. Meetings with industry to develop a guardrail suppliers QC plan will occur to implement a plan by January 2007. Due to workload and staffing issues, this task has been extended to fall of 2008.
Status: Fabrication section drafted a QC plan. This is on hold due to poor quality of wooden guardrail posts. This will be re-reviewed when the guardrail post issue is resolved.

Mike Polodna, Structural Materials Testing Engineer

WSU study on the use of low degradation aggregates in concrete.
Status: The first round of testing has begun at WSU. Specimens were cast in late 2008. Results from the first round are due in late 2009.

The WSDOT Construction Manual needs to be updated on how to check concrete mix designs. The construction manual needs to be updated with specific information on what needs to be checked on concrete mix designs so WSDOT Project Offices can independently check concrete mix designs.
Status: The mix design review form has been edited and is ready for inclusion in the Construction Manual.

Combined Gradation Update Nominal Maximum Size. The aggregate combined section in the Standard Specifications needs to be updated to reflect larger aggregate sizes. WSDOT allows 2 inch aggregate or larger in PCCP, but currently the combined gradation only covers up to 1-/2 nominal maximum size. The specifications need to cover 2 inch, 2-1/2 inch, and 3 inch gradations to the Standard Specifications Section 9-03.01(5) Grading.
Status: Proposed gradations have been developed and need to be reviewed at WACA before inclusion in the Standard Specifications.

Review the requirements for accepting and testing concrete cure. Determine if current testing standards need to be changed or remain the same. Determine if there are storage requirements for cure, both temperature and time related.
Status: Completed.

Masha Wilson, Chemical Materials Manager

Review and modify the paint specifications, Section 9-08 Paint. Review and subsequent revision of the specifications started in January 2008. This task is 95% complete.
Status: Necessary information and all applicable paint specifications were reviewed to determine what types of paint are no longer being used by WSDOT. Paint specifications were revised and updated accordingly. The ETG on Coatings was informed regarding new specifications, they were discussed and recommended changes were made. The updated specifications were reviewed by Kurt Williams and Mark Gaines. Further reviews by the ETG and final approval are pending.

The reviews, equipment set-up, verification and material testing for sealing compound tester from Applied Testing Systems Inc. was started in March 2008 and was completed in October 2008.
Status: Equipment verification and setup: Bond Test machine was manually adjusted to perform the required extension based on sample size. The machine was calibrated and verified using a linear regression analysis of inches of extension versus time. Standard Operating Procedure (SOP) was developed. Specification Section 9-04.2 (1) was updated and forwarded to management for review and implementation.

The technique of Infrared Spectroscopy (IR) is being employed to analyze the uniformity of a specific company's epoxy coating system formula over time. Our objective is to test and evaluate the uniformity of these epoxy systems and determine whether we can correlate spectrum differences (chemical formula variations) samples with failing physical testing and whether there was a change to the formulation of the same product.
Status: At present we have only received and studied several epoxy systems from the Sika Corporation, formula name Sikadur 35 Hi Mod LV. The part A components match one another to a much higher degree when they are overlaid, however there is one exception. One of the part A components had two extra peaks that were not detected in the other part A component samples. These two extra peaks indicate that there is some additional chemical (structural bonding) occurring in that sample. This sample did have a failed compression test.
The part B components in each of the systems appear to have a very noticeable amount of spectral variances. At this time these product differences do not seem to correlate with compression strength failure. It may be possible that part B can have slight variation without affecting the bonding of the entire bonding system. **At this time, we have been able to identify a few initial trends; however a larger number of sampling events would better support these findings.** This task is on-going and approximately **15 % complete.**

Dwight Carlson, Electrical and Signing Engineer

Grounding end bushing evaluation: Review the WSDOT specification for grounding end bushing to ensure the proper material is specified.
Status: Update submitted for implementation into Standard Specifications.

Electric service cabinet quality improvement project. Develop an inspection scheme to improve the quality of electrical service cabinet. Electric service cabinet manufacturers are now performing their own quality control inspection on electrical cabinets. WSDOT electrical inspectors are checking cabinets for QC checklist.
Status: Continue monitoring manufacturer QA program.

Signal turn on checklist: Develop a list of tasks to be completed by the Project Engineer prior to signal turn on. Checklist for signal turn on completed and submitted to HQ Construction Office for inclusion into Construction Manual.
Status: Update submitted for implementation into Construction Manual.

Update Standard Specifications Section 9-29 Illumination, Signal, Electrical. This section in the Standard Specifications has not been updated in a number of years and needs to be updated to remove outdated requirements and updated to include the latest standards. Need to identify and assemble Expert Task Group to review specifications (ETG Members identified).
Status: Initial Expert Task Group meeting set for September 2, 2008.

The purpose of this strategy is to investigate how WSDOT can contribute to the use of renewable energy in the daily operation of the highway system. The investigation will include research into how the use of solar energy can reduce the amount of and/or the cost of commercial electrical energy WSDOT consumes, through the use of existing resources or developing resources, in partnership with industry, which would have a predictable pay back.
Status:

Research and develop a specification and photometric acceptance for LED based roadway luminaries.
Status:

Linda Hughes, Quality Systems Manager

Develop videos for all materials testing procedures. November 2005 to September 2007
Status: Overall Project 88% complete; HMA - 100% complete; Aggregate Module; 95% complete; Concrete Module 60% complete; Density Module 10% complete. Online training has been put on the website for T 119, T 309 is in review, TM 2 and T 716 are 90% done, T 152 video is complete and ready for online training conversion.

Develop and implement online version of Quality Systems Manual.
• Produce online version of Quality Systems Manual that is accessible through WSDOT online manuals website and Materials Lab website.
• Format needs to be set-up so updates will be done at certain specified times of the year similar to Materials Manual.
• Develop online lab equipment inventory that is capable of being easily updated by Region and HQ Materials Lab.
Status: Draft Quality Systems Manual has been completely updated and is in review stage. The use of Remedy as an online inventory system is being researched. Remedy has the capability of allowing items to be barcoded and scanned into the system. Since the technology is available the cost to convert to a barcode system should be minimal.

Electronic Balances & Laboratory Equipment Calibration Costs
• Identify what laboratory equipment WSDOT can costs effectively calibrate in house, versus paying to have equipment calibrated.
• Electronics Scale Calibration Contract: If found to be cost effective; plan and implement WSDOT calibration of electronic scales
• Laboratory Equipment Calibration Contract: If costs effective plan identify Laboratory Equipment that WSDOT can calibrate costs effectively and what equipment requires contracting out.
Status: Task is complete. Equipment to be calibrated in house was identified with minor savings in the cost of calibration. Electronic calibration was found to be more cost effective when having an outside contractor perform the calibration because of the expense of purchasing and calibrating the standard weight sets.

Al Gabo, Assistant Construction Materials Engineer - Structural

Improve and streamline Annual Plant Approval document submittal and review process through email and scanning results in the finished approved documentation prior to meeting with fabricators for the annual plant approval meeting. July 2007 to June 2009.
Status: Streamlining of Annual Plant Approval process to result in approved documentation prior to annual meetings is 70% complete.

Cross-training of our E-2's in prestress, precast, crosshole sonic logging testing and miscellaneous materials inspection and documentation for uniformity. July 2007 to January 2009.
Status: Cross training E-2's in prestress, precast, crosshole sonic logging testing and miscellaneous materials inspection and documentation for uniformity is 80% complete.

Geotechnical

Steve Lowell, Chief Engineering Geologist

Develop strategy and implementation plan (including estimated cost, time, and FTE's required) to develop plan to include new and existing geotechnical borings statewide in a GIS database, and begin implementation.
a. Develop strategy and implementation white paper by Dec. 2007.
b. Get funding secured and boring log GIS database creation underway by July 2008.
c. Assigned to: Steve Lowell/Lynn Moses
Status: Status: A GIS specialist was hired as of Oct. 2006. A model to use for database development has been selected (FHWA nationwide geotechnical database). The detailed implementation strategy white paper is completed, but is yet to be implemented. A working group was established in August 2008 to begin carrying out the strategy to complete the database. OIT is reviewing the FHWA database, and future direction on this will be more clear once that is done. Funding needs are yet to be established.

Develop GIS platform useful for geotechnical purposes.
a. Identify target uses of the GIS platform and the layers needed by June 2008
b. Complete GIS platform by Dec. 2008.
c. Assigned to: Steve Lowell/Lynn Moses
Status: A GIS specialist was hired as of Oct. 2006, and an assistant has also been hired who is focused on project specific implementation as the platform is developed. Geotechnical workbench (version 1.0) has been completed, and will begin soon to work with the GeoServices GIS group to achieve final implementation. Deployment has been delayed due to workload issues at GeoServices. Implementation cannot proceed until GeoServices completes their tasks regarding this workbench.

Engineering geologists to work with regions that have state owned pits and quarries to identify marginal materials and to identify new sources of better materials. Begin with NE corner of the state and aggregates for HMA as pilot project.
a. Complete pilot project by June 2009 and develop plan to advance this effort to other parts of the state.
b. Assigned to: Steve Lowell/Lynn Moses
Status: Pilot project is funded and underway. Data from WSDOT pit and quarry database for Pend Oreille County has been compiled and analyzed. GIS layers have been developed. Field review of materials sources in study has been conducted. More extensive field work was completed in summer of 2008, on schedule. Draft report is in review.

Evaluate potential use of ring nets for rock slope stabilization through experimental features project.
a. Complete experimental features project preliminary report by June 2009.
b. Assigned to: Steve Lowell/Tom Badger
Status: FHWA approvals for experimental features project and waiver of "buy America" requirements have been obtained. Project development is completed. SR-28 Rock Island Slope Protection (w/ring net experimental feature) contract was awarded in December 2007 and is now complete. Draft end of project constructability report is in review.

Jim Cuthbertson, Chief Foundation Engineer

Implement liquefaction research by the U of W and others through updating the GDM and routine use of the liquefaction computer program produced as part of research project.
a. Install liquefaction program and train staff in its use by Dec. 2008.
b. Assigned to: Jim Cuthbertson
Status: Program is in final beta testing, and some staff have used it on a trial basis. Final report has been completed by Prof. Kramer, and the report has been published. Writing of GDM provisions has been completed. A revised Beta version was provided to WSDOT Dec 2008. Dec '08 and Jan '09, the new version was installed on PC's. Staff still needs to use the program and evaluate it for bugs. Anticipate comments back to U of W by March '09. If there are no issues, Staff Training will be developed and implemented before June '09.

Develop expertise and strategies to more accurately assess construction dewatering needs, including geotechnical characterization during design, and development of contract provisions that will provide a more accurate basis for bidding with regard to construction dewatering.
a. Hire licensed hydrogeologist, obtain computer design program(s) (e.g., MODFLOW) plus training, develop GDM guidance, and identify and develop specification changes by Dec. 2008.
b. Assigned to: Jim Cuthbertson/Mark Frye
Status: Mark Frye attended Dewatering Conference in Nov '08. Based on the conference, we concluded that generic dewatering specs are not recommended. As WSDOT does dewatering rarely, The recommendation is to hire this service through consultants and have them develop site specific specifications for jobs when needed. Funding and support for a new Hydrogeologist was put on hold in July '08 due to funding issues. This task is considered 100% complete Dec '08.

Develop strategy with the Bridge Office, and implementation plan, to include assessment of seismic foundation stability problems (primarily liquefaction) as part of Bridge Office seismic retrofit program. This effort, once put into motion, would identify specific bridges that are vulnerable to foundation stability problems, an assessment of the potential risk to the bridge and impact to the public, and an estimate of cost to address the instability so that these needs can be prioritized for programming purposes.
a. Develop strategy and implementation white paper by June 2009.
b. Assigned to: Jim Cuthbertson
Status: A conceptual level strategy has been developed to begin addressing this need. This strategy includes a first cut identification of bridges located in areas mapped as having liquefiable soils. Using GIS, a map that combines bridge locations with areas that are susceptible to liquefaction has been developed, and the overall number of bridges affected has been determined. A more detailed evaluation has been performed for bridges in specific corridors (SR-167, SR-405, SR-5, and SR-90) within currently funded Nickel and TPA projects. A more detailed statewide action strategy will be developed as part of the next highway system plan update - Program Management, with help from the Bridge and Structures Office and the Geotechnical Division, will take the lead. Executive level discussions on this issue have taken place, and a folio and PowerPoint presentation on the issue has been developed. HQ Program Management has just formed a committee to consider what needs to be done to address this issue for key corridors, and Tony Allen will participate on this committee.

Develop investigation and implementation plan for use of geogrids in pavement base coarse reinforcement and as subgrade reinforcement for pavements.
a. Summarize results from nationwide survey by June 2008.
b. Review research results obtained to date by others, and in consideration of nationwide survey results, determine what is known, and what is not known that needs to be known, developing preliminary design and use policies for geogrids for this application. Due by March 2009.
c. Identify potential test sites where this trial design policy could be tested. Do by June 2009.
d. Assigned to: Jim Cuthbertson
Status: The survey has been completed, but the final report on the survey is yet to be completed due to the heavy workload that has occurred during the past year. A draft final report for a pooled fund study on this subject (WSDOT is a study partner) has just become available and is in review.

Tony Allen, State Geotechnical Engineer

Develop more detailed chapter for the GDM on foundation design for marine structures, addressing the specific needs of WSF.
a. Complete final draft by June 2008
b. Assigned to: Tony Allen/Jim Cuthbertson
Status: A major update to the GDM was completed by the end of 2006, and another update is underway, targeted for completion in Sept. 2009. The development of new guidance on design of marine structure foundations has been part of this effort but there is still much to do to complete that particular chapter. The chapter on marine structure foundations was updated in 2006 to include special design objectives for marine structure foundations.

Continue to develop geotechnical design procedures in LRFD format for aspects of foundation and wall design that are not currently in LRFD format (soil nail walls, micropiles, noise walls, reinforced slopes, etc.), primarily through continued participation in the AASHTO Bridge Subcommittee and various NCHRP panels, and possibly other research.
a. This will be on-going; updated pile design provisions, new soil nail wall design provisions, and wall provisions are proposed for 2008.
b. Assigned to: Tony Allen
Status: WSDOT hosted the mid-year meetings of the AASHTO T-3 and T-15 technical committees in late 2007, and a web based meeting in November 2008, where new or updated design provisions were generated/prepared. Updated geotechnical seismic provisions, including liquefaction design, and some updates to Section 11 on walls were completed and approved by AASHTO in May 2008. A major update to the pile design specifications will be submitted to AASHTO for voting in July 2009. Updated seismic provisions for walls are anticipated for 2010.

Develop long range plan to fully implement MSE wall research (K-Stiffness Method).
a. Complete research reports and publish updated design method in well respected journals – submit journal papers supporting the use of the K-Stiffness Method for high silt content soils by November 2007
b. Work with other states/agencies to identify potential instrumented test walls, including those with lower quality backfill materials to establish accuracy of method
c. Complete RMC research and coordinate with NCHRP study to broaden applicability of research to lower quality backfill materials and also to seismic conditions
d. Prepare agenda item for AASHTO to include new design method in the AASHTO LRFD specifications
e. Assigned to: Tony Allen
Status: Numerous journal papers on the K-Stiffness Method have been published or are in the publication process in a number of international and domestic journals. The most recent work has been done with the assistance of a visiting scholar from Japan, in which the K-Stiffness method was shown to be valid for a series of Japanese walls, broadening the applicability and acceptance of this research. The method has now also been expanded to lower quality backfill materials through the evaluation of Japanese and other full scale wall case histories, and the K-Stiffness method now has a proposed modification to accommodate the cohesion that is usually present in lower quality backfill materials. A lower quality backfill source for use in the RMC full scale walls has been obtained and testing has begun (two full scale RMC walls have been completed and another test wall, the final wall planned for this study, is under construction), so that this adaptation of the K-Stiffness method can be refined. The final experimental features project report for the SR-18 test walls is near completion. Analysis and numerical modeling of all the data is underway, including calibration work to adapt the method for LRFD wall design.

Pavements

Jeff Uhlmeyer, State Pavement Engineer

Update WSDOT Pavement Policy
Status: The WSDOT Pavement Policy document has not been updated since 2005. Several developments have occurred over this period of time and require update of document (BST project selection, dowel bar type selections, etc.).

Monitor and evaluate (for at least a five year period or until failure) pavement performance and noise characteristics on the three (I-5, Lynnwood, SR-520 and I-405 - construction in 2009) quieter pavement test sections.
Status: Monitoring of Lynnwood began 2006, SR-520 began in 2007 and I-405 Next Generation Diamond Grinding will occur 2008 and OGFC placement in 2009.

Refine and update BST project selection (UW study has been completed and specifications have been updated).
Status: BST project selection criteria under development.

Develop dowel bar white paper explaining science and need for use.
Status: Complete - Paper written.

Investigate performance of HMA ¾ inch mixes.
Status: Complete - Paper written.

Ensure Next Generation Concrete Surface (NGCS) specifications are written and included in the I-5 Triage Project.
Status: Specifications are written and inclusion in the I-5 project is underway. Test section will be constructed April or May 2009.

WSDOT Pavement Preservation Communication Plan - Develop communication strategy and prepare document to communicate a.) the benefits form the P-1 program over the last 30 years, b.) the expected increase in costs or decrease in quality of P-1 not fully funded including discussion of the risks inherent in letting HMA pavements become past due, c.) Consider using folio (four pager), webpage, two-pager, Power-Point and other methods to communicate.
Status: Plan is being developed.

WSDOT Program Parameters - investigate ways to reduce P1 costs by expanding chip seals to higher volume roads, reduce HMA tin the 60/50 category and move to the 50/40 category, and ensuring future dues are not paved unless strong arguments support otherwise.
Status: Discussion with Program Management and Region is ongoing.

Quieter Pavement Communication Plan
Status: Summarizes pavement noise and pavement performance parameters to date.

WSDOT Concrete Needs
Status: Plan is being developed to communicate WSDOT's statewide 10 year concrete needs.

Jeff Uhlmeyer, Pavement Design Engineer

Summarize WSDOT's performance using Cold In Place Recycling.
Status: Report is under revision based on additional data.

Investigate Chip Seal Performance Cycles.
Status: Review is on hold.

Summarize the performance history of Modified D HMA - Modified D HMA has been widely used but what is the performance and associated costs?
Status: Report is complete.

Investigate performance issues with NE Washington HMA pavements.
Status: Report is complete.

During the 1990's, WSDOT placed several projects with rubber modified binder. Evaluate the performance of these mixes compared to WSDOT standard HMA performance.
Status: Report is complete.

PCCP Smoothness Specification.
Status: Project is on hold until measuring equipment can be modified.

Pavement Design Tools for Web.
Status: Project is on hold.

David Luhr, Pavement Management Engineer

New WSPMS Interface - Contract with Pavia Systems for a 3-year development of user interface for WSPMS.
Status: Continued development.

The WSPMS has been successfully functioning for over 40 years. However, no concise documentation of the WSPMS exists. This documents will summarize the existing publications as well as describe PMS concepts incorporated into the WSPMS.

Status: Document outline has been completed. WSPMS file processes have been documented, Profilometer calibration has been documented. WebWSPMS requirements document, and API document are complete.

With the intended deployment of the WebWSPMS in 2008/2009, the file building process will need to be documented and developed.
Status: Documentation of current file building process is complete, file processing software has been installed and tested.

Evaluation of Pavement Life - The Calculation of pavement life in the past few years has not been very rigorous, and many lane-miles of performance have been left out. A thorough method needs to be developed so Pavement Life statistics are automatically generated in the future.
Status: Initial calculations have been performed, results will be analyzed.

WSPMS Data Base Audit - Some fields in the database are blank, for certain years. Other data is not consistent. An audit needs to be done to identify problems with the data base and develop remedies.
Status: Work has begun on evaluation of data issues.

Evaluation of INO, texture and Skid Data - These data items have been collected for years, but a thorough analysis has never been done. The data needs to be evaluated to determine how it could or should be used in WSPMS.
Status: This work has not begun.

Develop WSPMS Notebook - Similar concept to the "Grey Notebook", the WSPMS Notebook can be a standard repository of statistics, graphs, and other performance indicators that any one can retrieve off of the internal web site. Items to include: WSPMS lane miles by type, fair or better condition plots, IRI data, construction lane miles by season, project costs, chip seal annual costs and more . . .
Status: Requirements document has been completed. Scope is being modified to not overlap with WebWSPMS.

Administration

Colleen Reynolds, Information Technology Systems Application Specialist

Identify new technology products and services that will benefit the Materials Laboratory and/or the employees.
Status: Technology fair was held on December 11, 2007. Project Complete

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Develop a plan to attain Materials Laboratory software compliancy, meaning do we have a license for all used software. Establish software used, interview division.
Status: All software identified, purchased, or removed from workstations. Project complete.

Ed Bellinger, Information Technology Systems Specialist

Disaster recovery
Status: This should evolve into a true business continuity plan, which might spawn different projects; Analysis, Solution Design, Implementation, Maintenance. This is still being slowed by OIT's process of trying to unify backup systems.

Identify new technology products and services that will benefit the Materials Laboratory and/or the employees.
Status: Technology fair for December 2008 is canceled due to budget shortfall.

Disaster Recovery / Business Continuity Implementation
Status: Currently doing DR/BC analysis. This has been delayed until a decision has been reached on enterprise backup hardware/software.

New PC Delivery checklist: Current installation procedure needs to be updated because of new software, interview process etc.
Status: New PC delivery precedence and priority document complete.

Shannon Huber-Lusk, Information Technology System Specialist

Table of organization for all units with brief description of what people do, FAQs, including what each unit does, who to contact, clean up old reports and data.
Status: Updating pages as data comes in. Rough draft of QSM page is on hold.

FAQs, including what each unit does, who to contact, clean up old reports and data.
Status: Have received data from Construction and Geotech. Rough drafts have been created and sent back for review.

Create an internal documentation webpage.
Status: Documentation newsletter page has been created. Internal Documentation page is in the works w/internal Construction webpage.

Kathy Brascher, Information Technology System Specialist

Develop and document requirements and plan for MATS for Phase 3 and 4.
Status: Requirements are complete for Phase 1 and 2 and plan is a living document. Requirements are underway for HMA Mix Design, HMA Reference Design, Soils, Aggregate and Preliminary Aggregate. Deployed into production. Bitmix lab is 100% complete.

Replace RegTec with MATS and continue to develop the remainder of MATS. Development is underway and expect to complete deployment of MATS by January 2008.
Status: Transmittal has been completed. Core process, cylinder and grout tests developed and in production. Looking at phasing in MATS and phasing out RegTec.

Replace Smartware with MATS and continue to develop the remainder of MATS. Development is underway and expect to complete by January 2009.
Status: Aggregate tests requirements complete and development is complete. All aggregate/preliminary agg tests are complete and in production as of December 2008.

Business Functions

New or Ongoing Construction/Materials/Pavements Research Projects

Optimal Timing of BST's on HMA and BST Pavements

Previous research determined the Average Annual Daily Traffic (AADT) threshold that we are currently using and modified the standard specifications for BST's. The next step is to determine the optimal time to place a BST on an existing BST or HMA pavement. BST's are seen as an effective and relatively inexpensive method of pavement surfacing, however, there is no reliable method to determine when the most cost effective time to apply a BST. The benefit will be the improved cost effectiveness of BST pavements and will result in better pavement performance and more efficient investments.

Optimum Initial HMA Density for Cold Weather Paving

HMA relies on secondary consolidation to occur in the warm summer months after paving, essentially rendering the HMA impermeable. Paving in colder weather exposes the HMA to winter weather before any secondary consolidation occurs, increasing damage from raveling, freeze-thaw, stripping, etc. Once damaged, the pavement continues to deteriorate at an accelerated rate and any loss of pavement life negatively affects the total life cycle cost of the HMA pavement. Therefore, the goal is to determine the optimum initial density necessary to take the place of secondary consolidation.

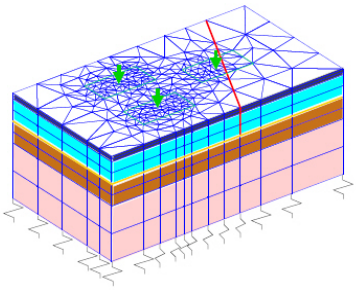
Determining Changes in Greenhouse Gas Emissions from Circa 1990 to Present Due to Changes in Pavement Technology

Climate change will impact every facet of asset management at WSDOT. Outside forces may drive inappropriate changes due to lack of information or lack of understanding. Understanding of the effects from pavement management, design, and construction can aid in developing accurate measures for climate change and greenhouse gas emissions (GGE). Therefore, the objective is to determine the contributions to GGE reductions due to improved pavement design, management, materials, and construction.

Determination of Optimum HMA Density Based on Pavement Performance

With the implementation of the Superpave mix design procedure and the asphalt binder specifications, there is concern that there may be issues related to HMA permeability, which can be offset by ensuring adequate density. Through the data in WSPMS and QA Spec/SAM, this research should determine how HMA density impacts pavement performance, and what level of HMA density is necessary to provide long-lived HMA pavements. In addition, determine how the QA specification has impacted pavement performance over time – the current HMA density specification has not been modified with the implementation of Superpave.

EverStressFE Modifications



EverStressFE is a finite element program for the structural evaluation of HMA pavements. Modification and enhancement of this pavement analysis tool is necessary in order to allow for full implementation and use in the calibration of the Mechanistic-Empirical Pavement Design Guide (MEPDG) procedure. The planned modifications will improve the ease of use, functionality, and the appropriate structural modeling of HMA pavements. This in turn will provide for more accurate prediction of HMA pavement performance, which is essential for the successful calibration, verification and implementation of the MEPDG.

Shrinkage Cracking in Concrete Bridge Decks

Recently, all of the WSDOT bridge decks constructed crack within the first 48 hours after the pour due to concrete shrinkage. The cracks occur in the transverse direction and are typically the full depth of the deck. The cracks provide an avenue for water and chlorides to penetrate the concrete and substantially diminish the deck's service life. This research is needed to determine the cause of the cracking and develop appropriate mitigation strategies.

Development of a New Drilled Shaft Acceptance Method

Drilled shafts using the wet method are typically accepted based on successful results of the Cross Sonic Logging test. This method of Quality Assurance testing can only verify the quality of concrete inside the shaft core and does not provide for verification of adequate concrete cover over the shaft rebar cage. There is a lack of reliable test methods to verify the quality of the entire concrete drilled shaft. This research will determine test methods that may be capable of testing for core concrete quality as well as the presence of adequate concrete cover outside the shaft rebar cage and determine the reliability and cost-effectiveness of those test methods.

Concrete Performance Using Low Degradation Aggregate

Generally, as low degradation materials are removed from a quarry, they are typically very hard with low LA wear values, therefore typical material testing cannot determine or predict long-term deterioration. As the low degradation materials are removed from the source and subjected to water, this type of material becomes altered to clay and will not perform as expected. This research will evaluate the long-term performance of concrete when using such aggregates, identify the potential long-term problems with the use of low degradation aggregates in concrete, and recommend test procedures and specifications for future use.

Best Practices for the Design and Construction of PCCP

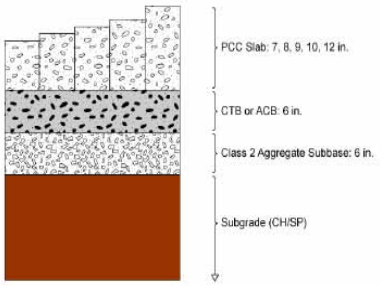
This research will provide the most effective and efficient methods of design and construction for use in PCCP design and rehabilitation/reconstruction. The first part of the study focused on stud wear of PCCP, which is a major obstacle in designing and maintaining PCCP over a life span of 50 plus years. The second part will focus on a life cycle assessment of varied options for reconstructing PCCP.

Evaluation of Dowel Bar Retrofit for Long-Term Life

The intended benefit of this research will be an improved understanding of dowel bar retrofit (DBR) pavements and a systematic method for best employing the DBR rehabilitation method. This should result in an improvement of pavement service and money savings. The goal is to better understand the issues surrounding DBR construction and its failure modes, thus allowing WSDOT to: (1) better specify construction standards, (2) specify appropriate rehabilitation applications, and (3) extend the effective pavement life of this type of rehabilitation.

CalME Flexible Pavement Design Software Evaluation

This research will provide a demonstration and additional validation of alternative models included in the draft software (CalME) and access to the details of the models and calibration data. Validation of the models and further debugging of the software will be performed by using state DOT project data to predict performance. Documentation of the feedback on the models and software will occur for future use by the state DOTs as they move towards implementation of mechanistic-empirical design methods.



Greenroads

Greenroads is a rating system developed at the University of Washington that distinguishes sustainability-focused new, reconstructed, and rehabilitated roads. It awards credits for approved sustainable choices/practices and can be used to certify projects based on total point value. Greenroads provides (1) a quantitative means to assess the sustainability and environmental stewardship of roads, and (2) a tool for decision-makers that allows them to make informed design and construction decisions regarding sustainability and environmental stewardship of a road. The goal of this research is to develop Greenroads into an implementable standard at the state DOT level.

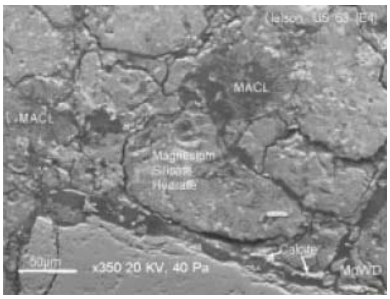
Effect of Chloride-Based Deicers on Reinforced Concrete Pavements and Structures

The focus of this research is the ingress into concrete of chloride-based deicers currently used by WSDOT for winter highway maintenance. Therefore, the emphasis will be placed on investigating the impact of deicer type and salt contamination on the corrosive behavior of rebar/dowel bars in concrete. The liquid deicers that are being tested include: $CaCl_2$, $MgCl_2$, and NaCl (all corrosion-inhibited). The control liquid deicer, against which test results will be compared, is non-inhibited NaCl. Testing is occurring on bridge and pavement sections. The bridge sections include plain rebar in the cracked and non-cracked condition. The pavement sections include dowels with a sawed joint – dowel types are: MMFX, epoxy coated, stainless steel tube with epoxy coated inside, 10 mil epoxy coated, and zinc coated.

Deicer Longevity and Cost-Effectiveness

The objectives of the proposed research are to evaluate the longevity of corrosion inhibitors in storage and on the road as well as their cost-effectiveness, and to establish a reliable measure to quantify the performance of anti-icing and deicing products. This research will allow the transportation agency to determine whether the inclusion of inhibitors into liquid or solid deicers is cost-effective, taking into account: the acceptable deicer corrosivity, reasonable duration of protection expected of inhibitors, and other agency-specific constraints.

Deicer Interaction with Concrete



Some deicing chemicals used for snow and ice control on roads and bridges may cause deterioration of Portland cement concrete. This deterioration is a complex process that involves both physical and chemical alterations in the cement paste and aggregates and is affected by the deicer chemistry, cement ingredients, aggregate reactivity, and environmental conditions. The long-term effect is the potential degradation on the concrete pavements and bridge decks. The goal of this study is to take concrete samples that are currently being exposed to the typical deicer chemicals used in Washington (NaCl, $CaCl_2$, and $MgCl_2$) and perform lab testing (such as x-ray diffraction, scanning electron microscope technology, etc.) to determine if the concrete is deteriorating from exposure to these chemicals.

Tire/Pavement Noise Research Consortium

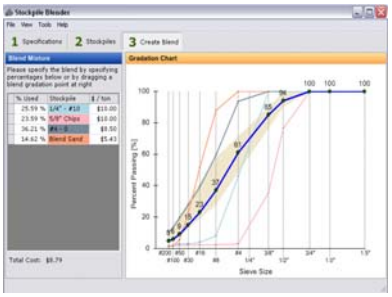
This consortium has been initiated to: provide a forum for states to discuss pavement noise issues, utilize the same measurement techniques to build a tire/pavement noise database, create a synthesis of global practice in regards to utilizing pavement technology for decreasing tire/pavement noise, determine the cost/benefits of using low-noise pavements, and provide guidelines for best practices in measuring and evaluating noise benefits and decreases over the wearing life of the roadway surface.

Western Pavement Preservation Partnership

The WPPP will pool the efforts of the participating agencies to provide a focused look at pavement preservation, and will partner with other regional and national pavement preservation efforts. Pavement preservation issues include pavement policy, specifications, field investigations, applied research, materials, and training.

Pavement Tools Consortium

The Pavement Tools Consortium fosters the continued development and implementation of computer-based paving tools, such as: Pavement Guide, Virtual Superpave Laboratory, Media Library, HMAView, PMSView, Stockpile Blender, XPactor, and EverFE. The major focus of the pavement tools is the enhancement of pavement-related training and construction operations.



State Pavement Technology Consortium (SPTC)

WSDOT is partnering with three other states (California, Minnesota, and Texas) which allows participation in a series of project meetings focused on sharing information, identifying critical issues of mutual interest, developing plans for joint research and testing, and educating transportation professionals on the latest developments in the design, construction, reconstruction and maintenance of highway pavements. The benefits of this arrangement have exceeded millions of dollars since its inception in 1999.

Pavement Reconstruction Scheduling Software

This consortium was formed through the SPTC to develop a software simulation tool which can be used to consider pavement design options along with construction scheduling, resource constraints, traffic management, and user-delays. The CA4PRS software is a construction and scheduling analysis tool to make sound construction project management decisions at each stage of the highway rehabilitation project: planning, design, and construction. CA4PRS estimates how many miles of pavement can be rehabilitated or reconstructed under different traffic closure strategies with given project constraints of: pavement design, lane closure tactics, schedule interfaces, contractor logistics and resources.

Ongoing Geotechnical Research Projects

LRFD Procedures for Geotechnical Seismic Design

Develop a framework to determine load and resistance factors that would, accounting for uncertainties in earthquake occurrence and effects, produce designs with reliabilities consistent with those achieved by LRFD procedures for high-probability loading conditions. Development of reliability-based design procedures will allow seismic aspects of design to be consistent with non-seismic aspects, and will allow the reliability of geotechnical elements to be balanced with the reliability of structural elements. They will also allow uniformity across geographic regions – structures in all of the various seismic environments of Washington would be designed for consistent reliability.

Subsurface Drainage for Landslide and Slope Stabilization

Research is needed to identify, collect and develop best practices and guidelines to raise the standards for subsurface drainage design, installation, and maintenance. This research is especially important because subsurface drainage is typically the most cost-effective stabilization measure, often being an order of magnitude less than other commonly employed slope stabilization measures. In addition, the research should explore new applications of existing materials and technologies that can be advantageously applied to subsurface drainage systems for slope stabilization.

Strength and Deformation Analysis of MSE Walls at Working Loads

This work has developed an improved method for internal stability design of MSE retaining walls, the K-Stiffness method. This method appears to produce a more cost-effective design for MSE walls as compared to the AASHTO Simplified Method. The K-Stiffness method has only been developed and validated for high quality sandy backfill soils. The next two phases will extend the K-Stiffness method to 1) marginal quality backfill materials and 2) full-scale field walls that will be monitored for validation. The validation of the K-Stiffness method for marginal quality backfill materials and monitoring full-scale walls is necessary to incorporate this method into the AASHTO LRFD design specifications.

Recently Completed Construction/Materials/Pavements Research Projects

Dynamic Modulus Test – Laboratory Evaluation

A database of dynamic modulus values for typical Superpave mixes widely used in the state of Washington was developed and used to investigate the sensitivity of the dynamic modulus to aggregate gradation. Statistical analysis showed that using different JMF mixes significantly affected the dynamic modulus. This was not the case when modifying the JMF by changing the percent passing #200 by ±2%. With the dynamic modulus as the key input into the MEPDG, Level 1 and Level 3 predictions of rutting, longitudinal cracking, alligator cracking, and IRI were compared with the field performance data. The MEPDG predicted IRI and alligator cracking reasonably well and the predicted rutting of the JMF mixes agreed well with the dynamic modulus trend.

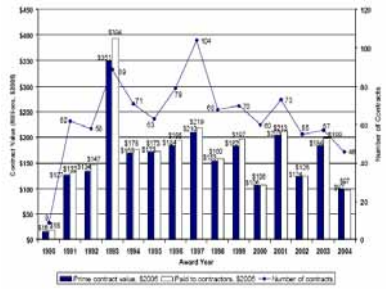
Rapid Pavement Construction Case Studies

This project discusses the implementation, use and experience of using the following items related to rapid pavement construction: CA4PRS, PCCP panel replacement, polymer concrete, and traffic closure windows. CA4PRS was tested in two case studies and has proved capable of providing meaningful scheduling and productivity inputs into early project planning. Panel replacement techniques and polymer concrete construction are reviewed (including contractor interviews) in an effort to document past successes and failures as well as key decision points when making future project decisions. Finally, a review of traffic closure windows for rapid construction is presented.

Bituminous Surface Treatment Protocol

The objectives of this research were to (1) improve the criteria on when and where to use bituminous surface treatment (BST) surfacings and (2) examine and modify, if necessary, the standard specifications for BST's. Both objectives were accomplished and are currently being utilized. The benefits are the enhancement of the Pavement Preservation Program with improved understanding and use of BSTs.

Performance Based Contracting



The objectives of this research were to develop tools that will: (1) monitor the contractor's performance during construction in order to detect any unsatisfactory progress, and (2) improve the time and cost prediction of highway projects in order to reduce time and cost overruns. Time and cost prediction models were developed (based on WSDOT historical data) on the basis of a number of major variables in pavement projects, including project duration, final contract value, HMA quantity, grading, surfacing, and the number of project highway miles.

Composite Materials for Ferry Wingwall Structures

This research focused on investigating wood plastic composite (WPC) applications in waterfront structures, specifically as a replacement for preservative-treated timber rubbing blocks in wingwall structures. Currently, timber members serve as the contact interface in wingwall structures for ferry vessel berthing in the Washington State Ferry system. Due to environmental concerns with preservative-treated timber and the lifespan of timbers in marine environments, WPC alternatives are being sought. In order to investigate the structural demands of ferries berthing into wingwall structures, specifically the demand on existing timber rubbing blocks as well as potential WPC replacement members, dynamic finite element analyses were performed. Also, new wood-plastic composite formulations and structural capacity assessments were performed.

Dynamic Internal Angle for the Superpave Gyratory Compactor

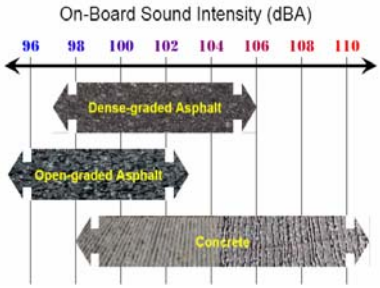
This study on the angle of gyration for Superpave compactors was done to determine if there is a difference in the bulk specific gravity – and ultimately the volumetric properties – when calibrating the compactor's angle of gyration internally and externally. It was found that 41 percent of the compactors tested were not in specification when using the internal angle to calibrate the compactor. The result was that the measurement of the bulk specific gravity affects the volumetric properties of HMA and therefore can have an affect on the design and acceptance of HMA.

De-bonding Cracking in Hot Mix Asphalt Pavements

De-bonding cracking can occur when a HMA surface layer acts independently due to lack of bond with the underlying pavement structure. The fatigue cracks form in the typical bottom-up fashion, but because the surface layer is independent from the underlying pavement, the cracks form in only the surface layer. This study gathers initial evidence on de-bonding in Washington State and attempts to define the problem scope and potential performance impacts. Specifically it attempts to (1) determine if de-bonding occurs, (2) identify possible de-bonding mechanisms, (3) define the scope of de-bonding in WSDOT pavements, (4) determine de-bonding impacts on pavement performance, and (5) identify the role of tack coat in de-bonding.

Investigation of Quieter Pavement Performance

This study looked at the performance of quieter pavements in use in the US and Europe with specific emphasis on those states that are using open graded mixes for both friction and porous courses on an ongoing basis. All States were contacted and 34 states responded with information on their use of Open Graded and SMA mixes. Eleven states were able to provide an estimate of the range and average service life of their open graded mixes and three states provided information on the service life of their SMA mixes. Specifications for Open Graded and SMA mixes were compiled from 20 states and compared to Washington State's Open Graded Friction Course mix and the Open Graded mix used on recent test sections built by WSDOT.

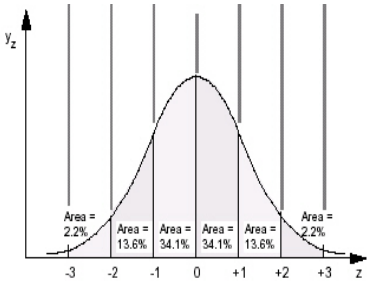


I-5 Corridor Pavement Reconstruction

This project provided long-range planning for the pavement through the I-5 Seattle Corridor. The objectives of this study are three-fold: (1) assess the pavement life of each segment within the 28 mile I-5 urban corridor and determine the estimated terminal distress type and timing, (2) develop improved PCCP performance analysis tools and procedures (EverFE), and (3) initiate a visualization process that can convey the current and future conditions to decision makers and the general public.

Statistical Assessment of QA/QC Data for HMA

Recent trends in the paving industry have resulted in increased contractor involvement in the design, acceptance, and performance of HMA pavements. As a result, questions have arisen about whether contractor process control tests (or QC) should be incorporated into the acceptance and pay factor processes that state highway agencies currently use. To examine this issue, statistical F and t-tests were used to compare QC to QA results. The results of the statistical analysis were analyzed from both a statistical and engineering perspective. Additionally, best practices for both specification and pay factor systems that may attenuate the impact of potential differences between QC and QA results are discussed.



Effect of Aggregate Gradation on Dynamic Modulus

This work used data in a NCHRP database that was used to develop models in the MEPDG to statistically evaluate the effect of aggregate gradation on the dynamic modulus of HMA. This information will be used in the implementation of the MEPDG within WSDOT and could also affect HMA mix design procedures.

Recently Completed Geotechnical Research Projects

Evaluation of Liquefaction Hazards

This research has been active for over the past six years, with phases 1 and 2 of the project setting the stage for the WSDOT Liquefaction Hazard Evaluation System, a computer program designed to perform multiple sophisticated analyses. The program implements several new methods of analysis and a number of widely used existing methods of analysis. The Manual provides recommendations on how to use each of these analyses, but the program allows the user to combine their results in a manner that allows the attributes of each to be realized.

In-House Pavement Research

The following is a list of all completed, in-progress, and new research topics that are being investigated by the Pavements Division. Completed reports and TechNotes are available on the Materials Lab Pavements Division web site at http://www.wsdot.wa.gov/biz/mats/pavement/.

Pavement Performance of ¾ inch HMA (COMPLETE)

Based on the results of a forensic investigation of an early failure of a ¾ inch HMA wearing course, this study reviewed the construction records and pavement performance data to determine if there are any performance issues with this mix. The report found that three quarter inch mixes were not performing any better or worse than other HMA types.
The report can be viewed at http://www.wsdot.wa.gov/biz/mats/pavement/ThreeQuarterInchHMA.pdf

History of Rubberized Asphalt Use in Washington State (COMPLETE)

Rubberized asphalt pavements have been used in Washington State since 1977 with varying amounts of success. This report documents the use of rubberized asphalt pavements in Washington and evaluates their performance and cost effectiveness versus conventional asphalt pavements.
The report can be viewed at: http://www.wsdot.wa.gov/research/reports/fullreports/693.1.pdf

Pavement Performance of Class D modified (COMPLETE)

Class D Modified pavements have been constructed across the state on a variety of roadways. In western Washington, these pavements experienced poor performance due to rutting. In eastern Washington, the performance has been mixed reviews. This study will summarize the performance of these pavement types.
This report will be online soon. Please contact the Pavements Division of the Headquarter Materials Lab to request a copy.

Evaluation of pavement Failure in NE Washington Pavements (COMPLETE)

In the northeast corner of Washington State, the Eastern Region has noted that many of the pavements placed in the last five years are demonstrating early distress (primarily in the form of raveling).
This investigation evaluated the design, construction and pavement performance of these projects to determine if there is an identifiable cause of the early distress. The investigation concluded that paving late in the season caused the early distress.
The report was not published online. Copies can be requested through the Pavements Division of the Headquarters Materials Lab.

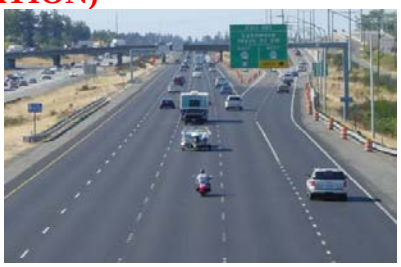
Studded Tire Wear Of PCCP Pavements (UNDER EVALUATION)

The performance of portland cement concrete mixes with higher flexural strength, higher cement content, and with Hard-Cem additive and carpet drag finish will be evaluated over a period of five years to determine if they are more resistant to studded tire wear. Special sections of each mix will be tested over a five year period to determine the rate of studded tire wear as compared to the WSDOT standard 650 psi flexural strength mix and tined finish. In addition, the carpet drag finish will be compared to transverse tining with regard to providing adequate friction resistance over time and reducing tire/pavement noise.
The wear results show that none of the sections are performing any better than the standard 650 flexural strength control section. Friction test results indicated that the carpet drag finish was quickly removed by studded tire wear.
The Experimental Feature Report can be viewed at http://www.wsdot.wa.gov/biz/mats/pavement/Argonne_SullivanDraftReport.pdf

Experimental Feature – Carpet Drag and Longitudinal Tining (UNDER EVALUATION)

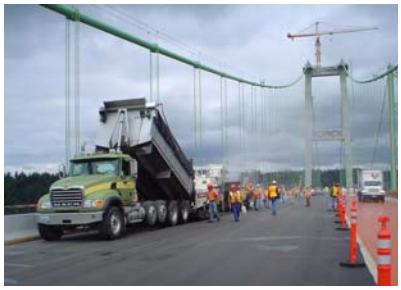
Experimental features on I-5 Stage 4 and I-5 317th (Federal Way vicinity) will evaluate the durability and noise reduction characteristics of the carpet drag surface texture.
The Post Construction and Performance Reports can be viewed at:
http://www.wsdot.wa.gov/biz/mats/pavement/FederalWaytoSouth317thStHOVDirectAccessSept2006.pdf and
http://www.wsdot.wa.gov/biz/mats/pavement/PCCP_LongitudinalTining.pdf

Experimental Feature – Quieter Pavement (UNDER EVALUATION)



As a result of the study on *Quieter Pavement: Options and Challenges for Washington State*, WSDOT has developed two Experimental Feature test sections to evaluate the construction and performance of hot mix asphalt quieter pavement (open graded friction course). The test sections evaluate two types of open graded friction course, one that utilizes an asphalt-rubber binder and one that utilizes a polymer modified asphalt binder. The first test section was constructed during the summer of 2006 on I-5 52nd Avenue to SR-526 (southbound only). The second test section was constructed in the summer of 2007on both direction of SR-520 between Evergreen Point Road and I-405. None of the OGFC sections on either project are quieter than the conventional HMA as of January 2009. The OGFC-Rubber sections on both projects are showing up to 5/16 inch of rutting due to raveling from studded tire wear.
The Post Construction and Performance Reports can be viewed at
http://www.wsdot.wa.gov/biz/mats/pavement/LongTermPavementPerformance.pdf
http://www.wsdot.wa.gov/biz/mats/pavement/LongTermPavementPerformanceProject2.pdf

Trinidad Lake Asphalt (UNDER EVALUATION)



The new Tacoma Narrows Bridge incorporated a steel bridge deck which requires an overlay which is highly resistant to cracking. The HMA overlay incorporated Trinidad Lake Asphalt to improve its cracking resistance.
The Post Construction Report can be viewed at
http://www.wsdot.wa.gov/biz/mats/pavement/TrinidadLakeAsphaltOverlay.pdf

Concrete Maturity (IN PROGRESS

Three projects were reviewed to evaluate the use of maturity to predict the in place strength of concrete pavement. The review found that maturity can be used for the early prediction of strength, however, additional training of both WSDOT and Contractor personnel is needed before this technology can be fully implemented and used statewide. Final report of the maturity meter and its use on WSDOT projects is currently being reviewed in-house.

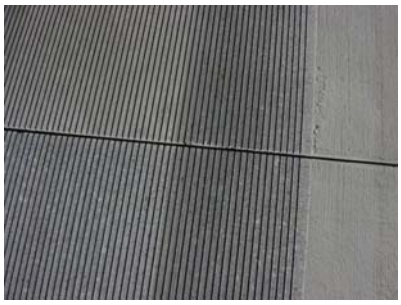
Experimental Feature – MMFX dowel bars (IN PROGRESS)

MMFX 2 Steel is an uncoated, high corrosion resistant steel-reinforcing product that meets or exceeds the mechanical properties of ASTM A615 Grade 75 steel. MMFX 2 Steel is a high chromium and low carbon steel in comparison with conventional ASTM A 615 steel. Its chromium content (9 to 10 percent) almost approaches that of stainless steel. The purpose of this experimental feature is to use MMFX 2 Steel dowel bars at each transverse joint in the new concrete pavement.

Pavement Joint Adhesive (IN PROGRESS)

Longitudinal joints are often the first area to fail on HMA pavements. This experimental feature evaluates performance of joints constructed using a bituminous joint adhesive instead of the traditional emulsified asphalt. Preliminary results indicate excellent performance from those projects that used the adhesive

Experimental Feature – NGCS (IN PROGRESS)



The Next Generation Concrete Surface (NGCS) is a grooved PCCP surface texture produced by diamond grinding which is reported to reduce tire pavement noise. This experimental feature will evaluate noise reduction characteristics, studded tire wear, friction, durability and reduction of splash and spray of the NGCS. A 1000 foot section of NGSC will be installed between the Lake Washington Ship Canal Bridge and the Ravenna Blvd. Overcrossing in the summer of 2009.

Warm Mix Asphalt (IN PROGRESS)

Warm mix asphalt is a bituminous mixture which can be produced and placed at lower temperatures. Lowering the production temperature means the mix requires less energy to produce leading to a corresponding reduction in greenhouse gas emissions. The lower placement temperature also aids in achieving compaction. This experimental feature documents the construction and performance of warm mix asphalt placed on I-90 west of the town of George. The warm mix test section was successfully placed on I-90 at 30°F to 50°F lower mixing and placement temperature than the conventional hot mix used on the remainder of the project.

The Post Construction Report is near completion.

Experimental Feature – Longitudinal Tining (IN PROGRESS)

The performance of longitudinal tining will be evaluated on two projects, I-405 112th Ave SE to SE 8th St and SR 16 Westbound Nalley Valley I/C. The evaluation will focus on noise reduction, friction and resistance to studded tire wear in both HOV and general purpose lanes.

Cold In-Place Recycling (IN PROGRESS)

This study will describe the cold in-place recycling process and document design, construction, cost and performance of WSDOT projects.
Report is currently being finalized.

Pavement Smoothness Specifications (IN PROGRESS)

This study will summarize state highway agencies experience with smoothness specifications, evaluate current Eastern and Southwest Regions projects that required a smoothness specification, and develop a draft specification, for both hot mix asphalt and portland cement concrete for review by WSDOT, WAPA, and ACPA.
Hot mix asphalt special provision have been developed and implemented on several HMA projects. PCC specification is still under development.

Performance Measures

Construction Materials Roadway

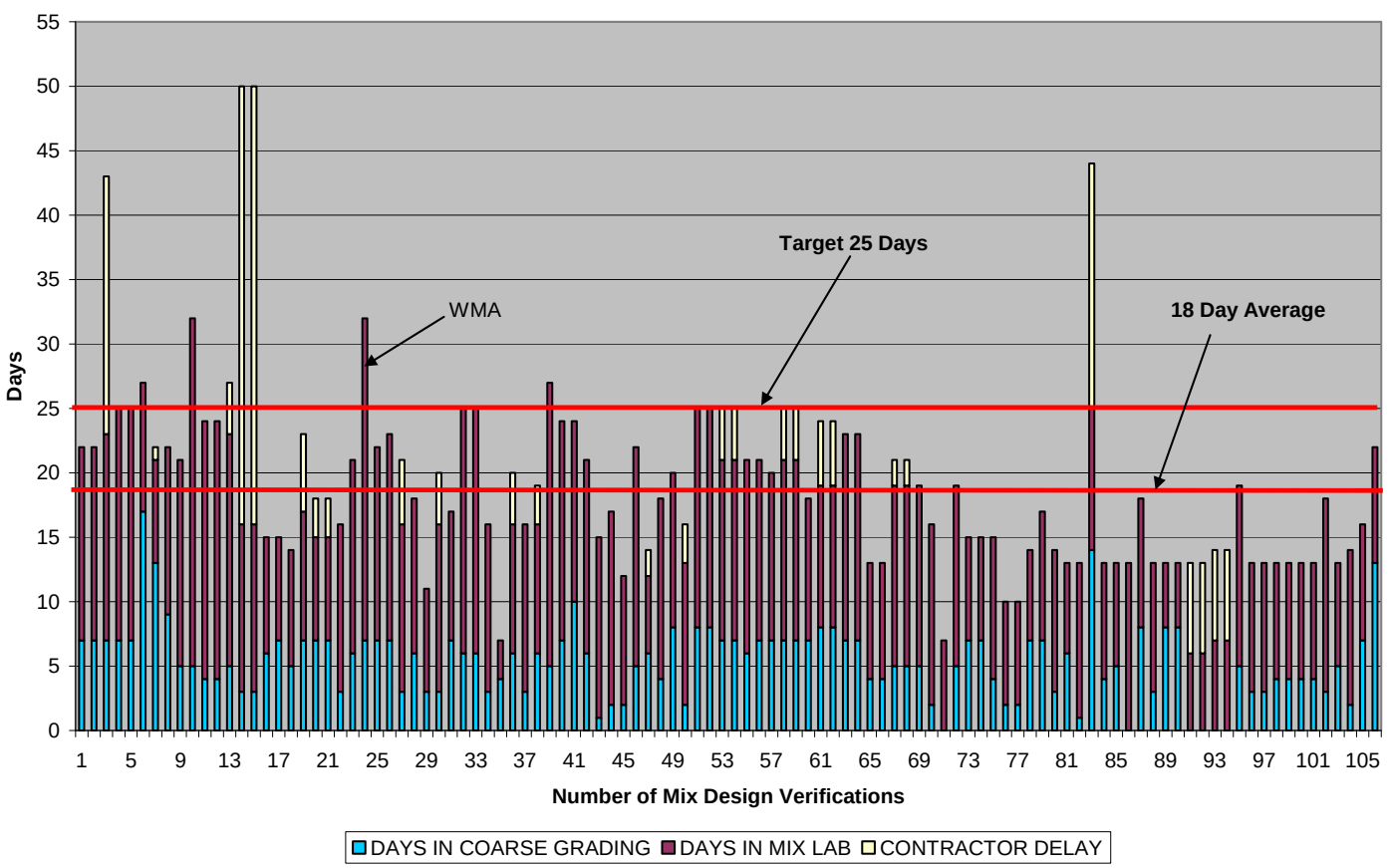
Hot Mix Asphalt Design Verifications 2008

Standard Specification 5.04.3(7)A Mix Designs, states "Prior to the production of Hot Mix Asphalt (HMA), the Contractor shall determine a design aggregate structure and asphalt binder content in accordance with WSDOT Standard Operating Procedure 732. Once the design aggregate structure and asphalt binder content have been determined, the Contractor shall submit the HMA mix design on DOT form 350-042 demonstrating that the design meets the requirements of Sections 9-03.8(2) and 9-03.8(6). A mix design verification report will be provided within 25 calendar days after a mix design submittal has been received at the State Materials Laboratory in Tumwater."

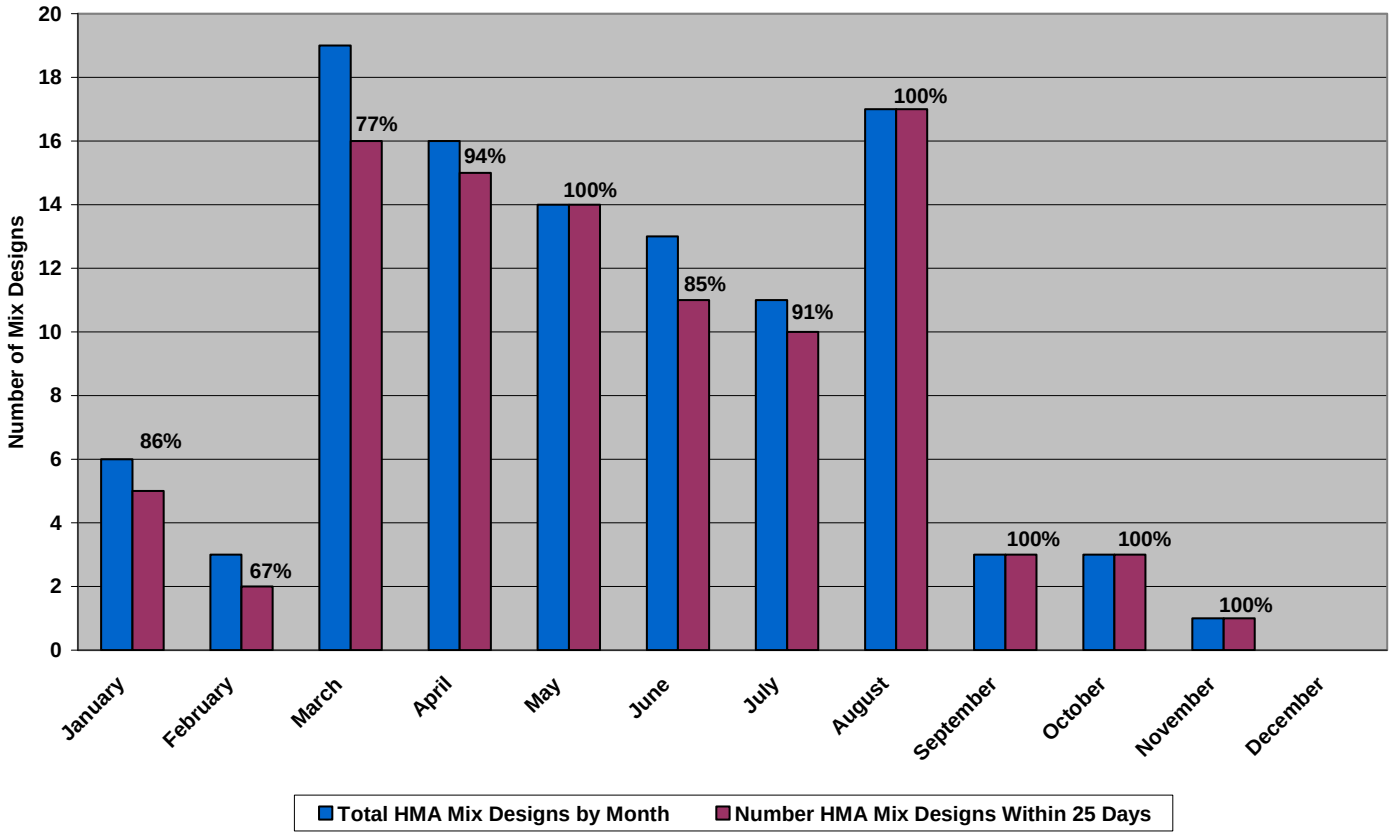
Factors that can affect the 25 day completion schedule:

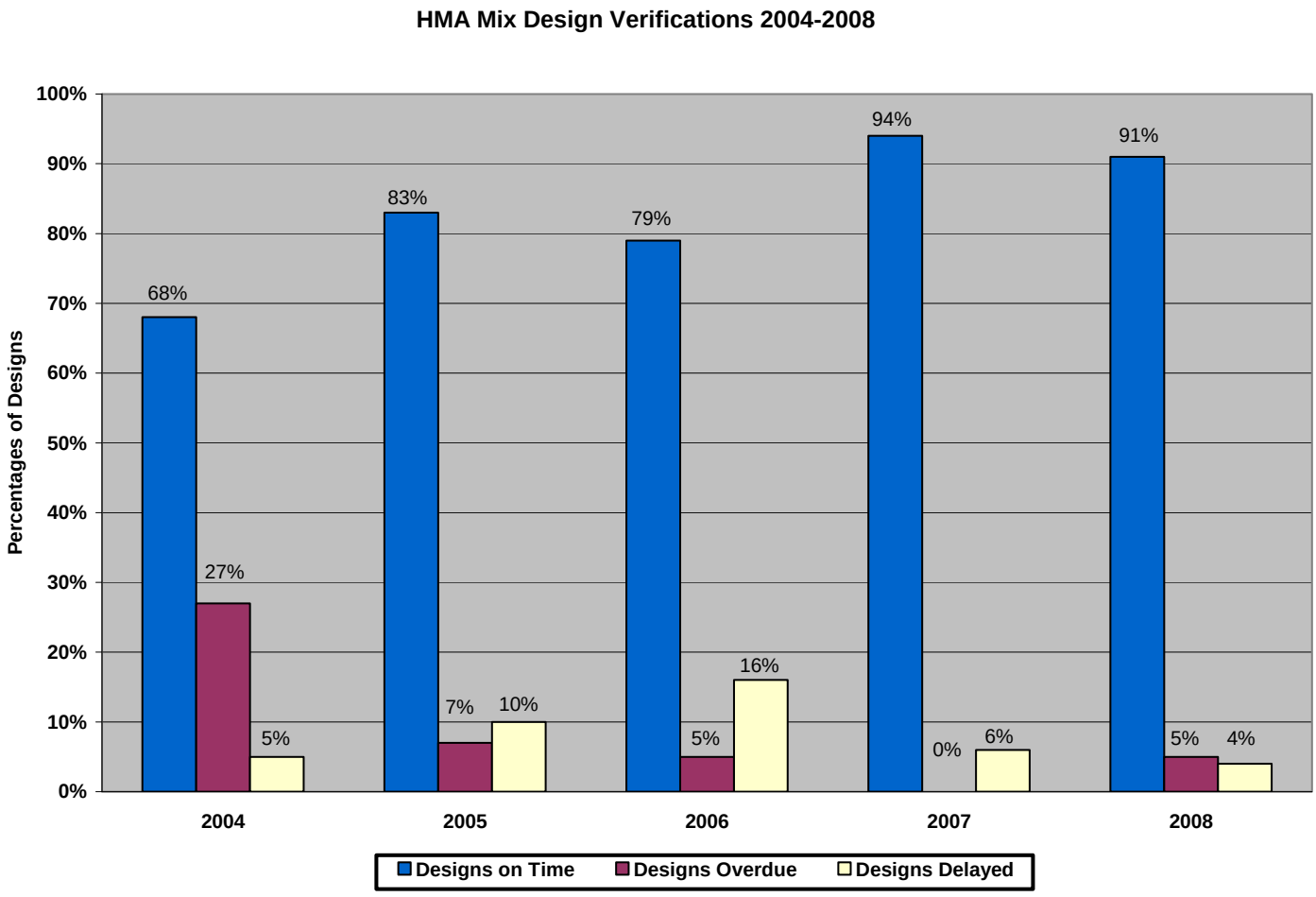
- Work load in Physical Testing Section
- Undersized or non-representative samples
- Delays in asphalt binder shipments from suppliers
- Work load in the Bituminous Materials Section
- Special handling of designs
- FTE's
- Equipment and laboratory space
- Overtime authorization

In 2008 the Bituminous Materials Section completed 106 HMA mix design verifications. 95 of these design verifications were either completed on or before their due date, 6 design verifications were not completed within 25 calendar days, and 5 were delayed for reasons external to the Bituminous Section. Of the 6 design verifications that were not completed within the 25 days, one was the Warm Mix Asphalt project which required the Bituminous Mixtures Laboratory to perform special testing to complete the mix design. The other 5 design verifications had questionable data and it was necessary to order extra material for additional testing. Two design verifications were cancelled by the Project Engineer during the verification process.


HMA Mix Design Verifications 2008
Days
55
50
45
40
35
30
25
20
15
10
5
0
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
65
69
73
77
81
85
89
93
97
101
105
Number of Mix Design Verifications
Target 25 Days
WMA
18 Day Average
DAYS IN COARSE GRADING
DAYS IN MIX LAB
CONTRACTOR DELAY

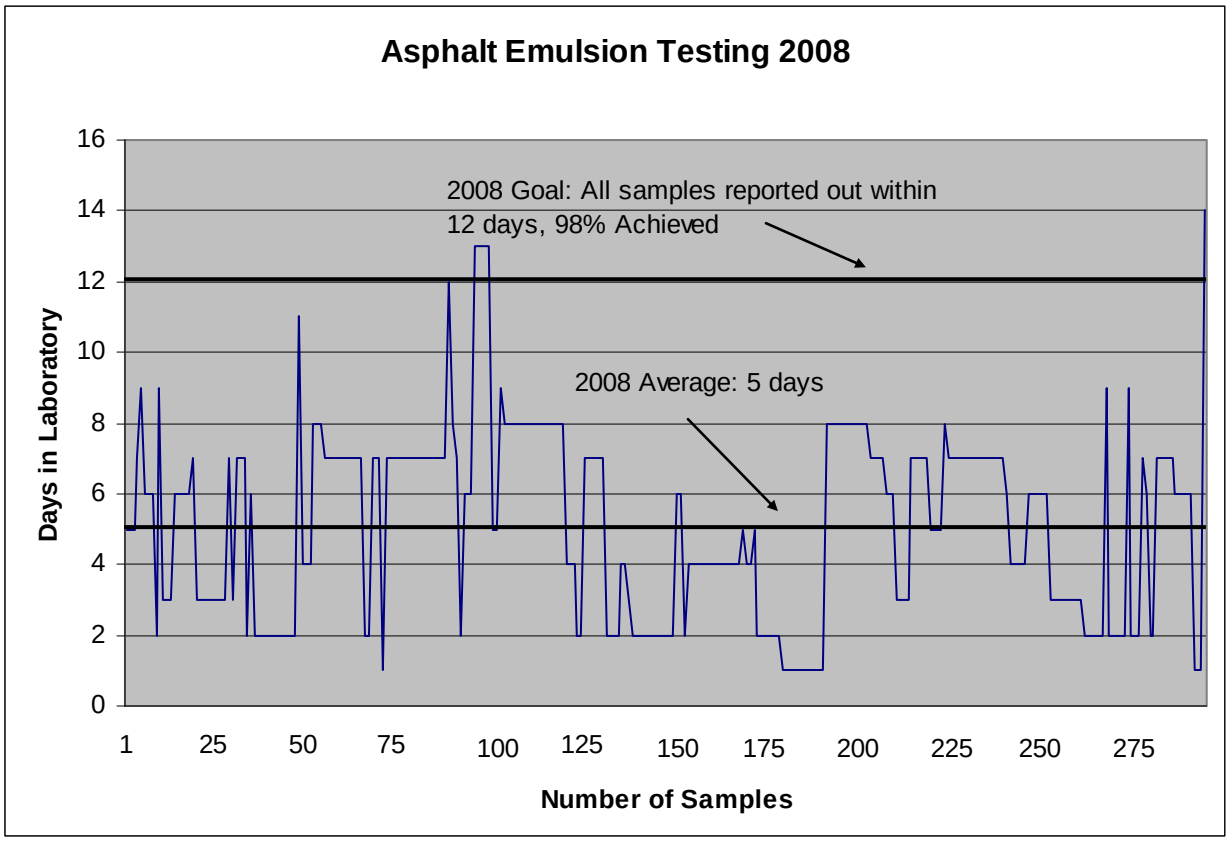
HMA Mix Designs for 2008
Days in Laboratory by Month



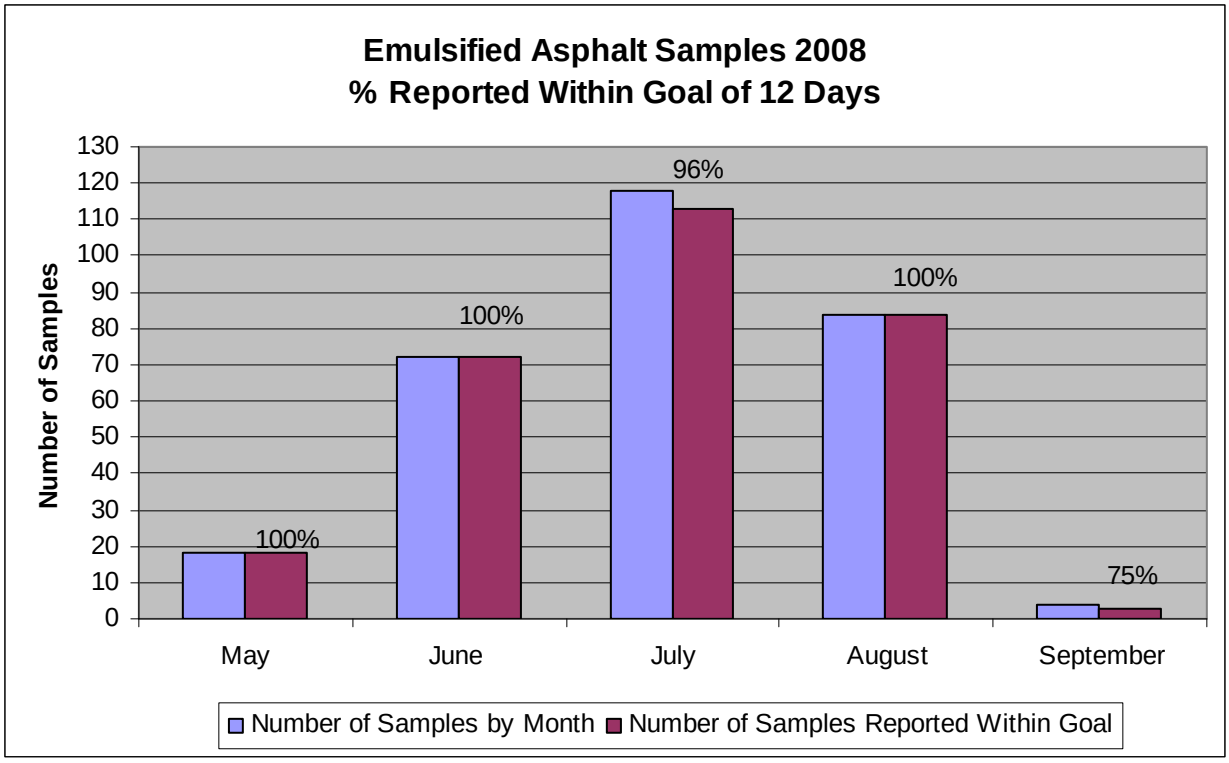

HMA Mix Design Verifications 2004-2008
Percentages of Designs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
68%
27%
5%
83%
7%
10%
79%
5%
16%
94%
0%
6%
91%
5%
4%
2004
2005
2006
2007
2008
Designs on Time
Designs Overdue
Designs Delayed

Asphalt Emulsion Testing 2008

As stated in the WSDOT Construction Manual section 9-5.7 "Acceptance Sample and Testing Frequency Guide" states that Asphalt Emulsions shall be sampled from every other shipment to the project. Asphalt Emulsions used exclusively for tack coat (such as STE-1 and CSS-1) do not require sampling or testing.
The first Asphalt Emulsion sample taken for each day of production, per contract, receives a complete series of tests per Standard Specification 9-02.1(6), all other samples taken each day are tested and tracked for consistency using Saybolt Viscosity.
The chart indicates the time of testing for all the emulsion samples received in 2008. Average time to report out an emulsion sample is 5 days.



The 2008 Bituminous Materials Section goal for testing and reporting out Asphalt Emulsion samples is 12 days. To achieve this goal the Liquid Asphalt Laboratory may utilize additional days and overtime to ensure that testing begins on all emulsion samples within 5 days of receipt.


Emulsified Asphalt Samples 2008
% Reported Within Goal of 12 Days
Number of Samples
130
120
110
100
90
80
70
60
50
40
30
20
10
0
100%
100%
96%
100%
75%
May
June
July
August
September
Number of Samples by Month
Number of Samples Reported Within Goal

HMA Mix Design Conformation Samples 2008

In 2007, the Bituminous Materials Section began measuring the timeliness for completion of HMA Mix Design Conformation Samples. Mix design conformation samples are actual split samples taken during production and tested for comparison to original mix design properties. For all projects, conformation samples are taken one per day from the first five days of production for each plant and one sample every fifth day of production thereafter. This production data can also be used to determine if a mix design is acceptable for use on additional paving projects. The Bituminous Materials Section occasionally tests challenge samples and/or assists in the troubleshooting of problematic HMA issues outside the normal conformation sample testing schedule. Although conformation samples do not have a formal timeline for completion, the 2007 construction season was used to measure and monitor the completion of samples to establish a baseline for subsequent years.

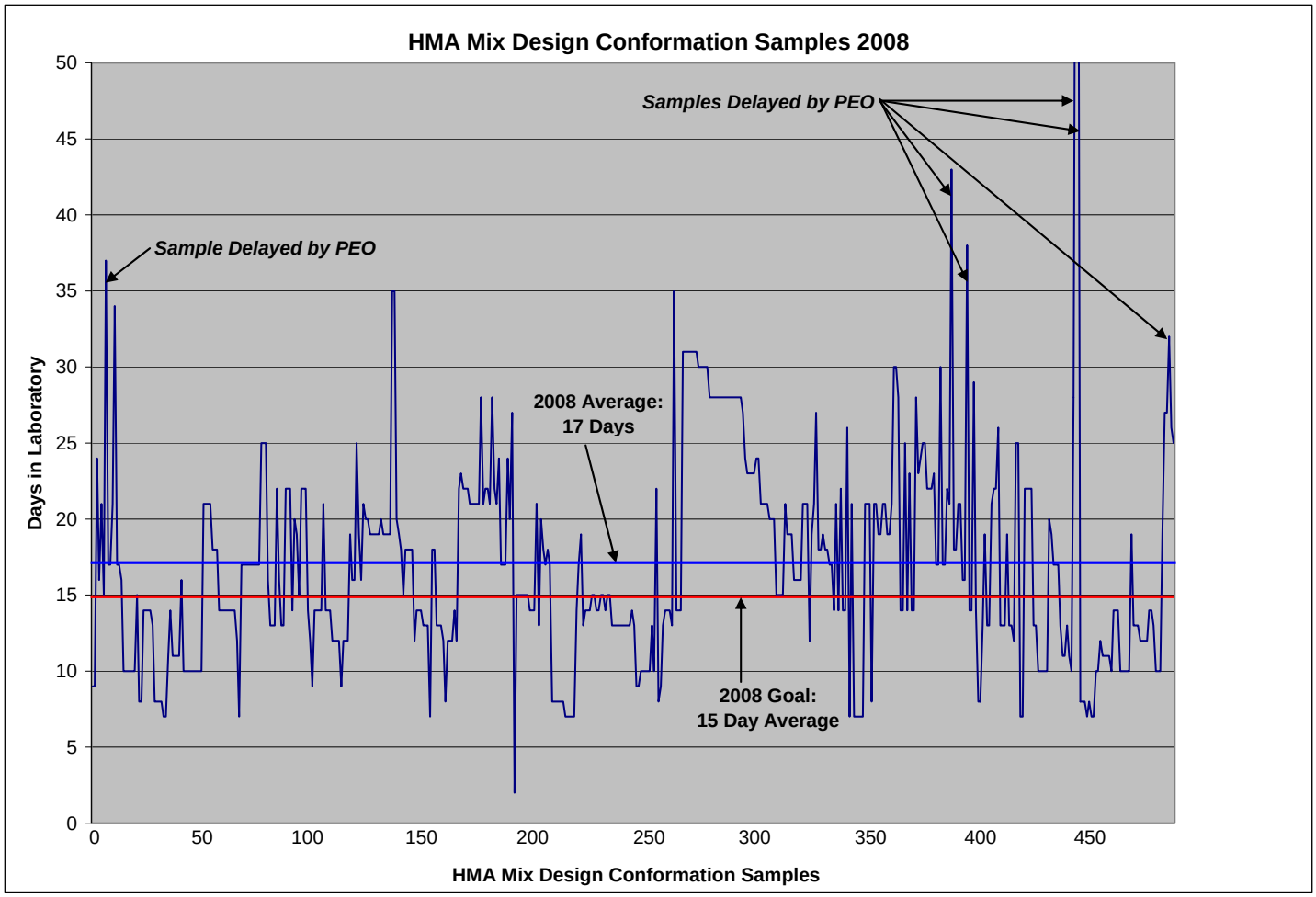
The basis for this Performance Measure is measured by the number of days from when it was received at the Headquarters Materials Laboratory until it is tested and logged out by the Bituminous Materials Section.

Factors that can affect a timely completion schedule:

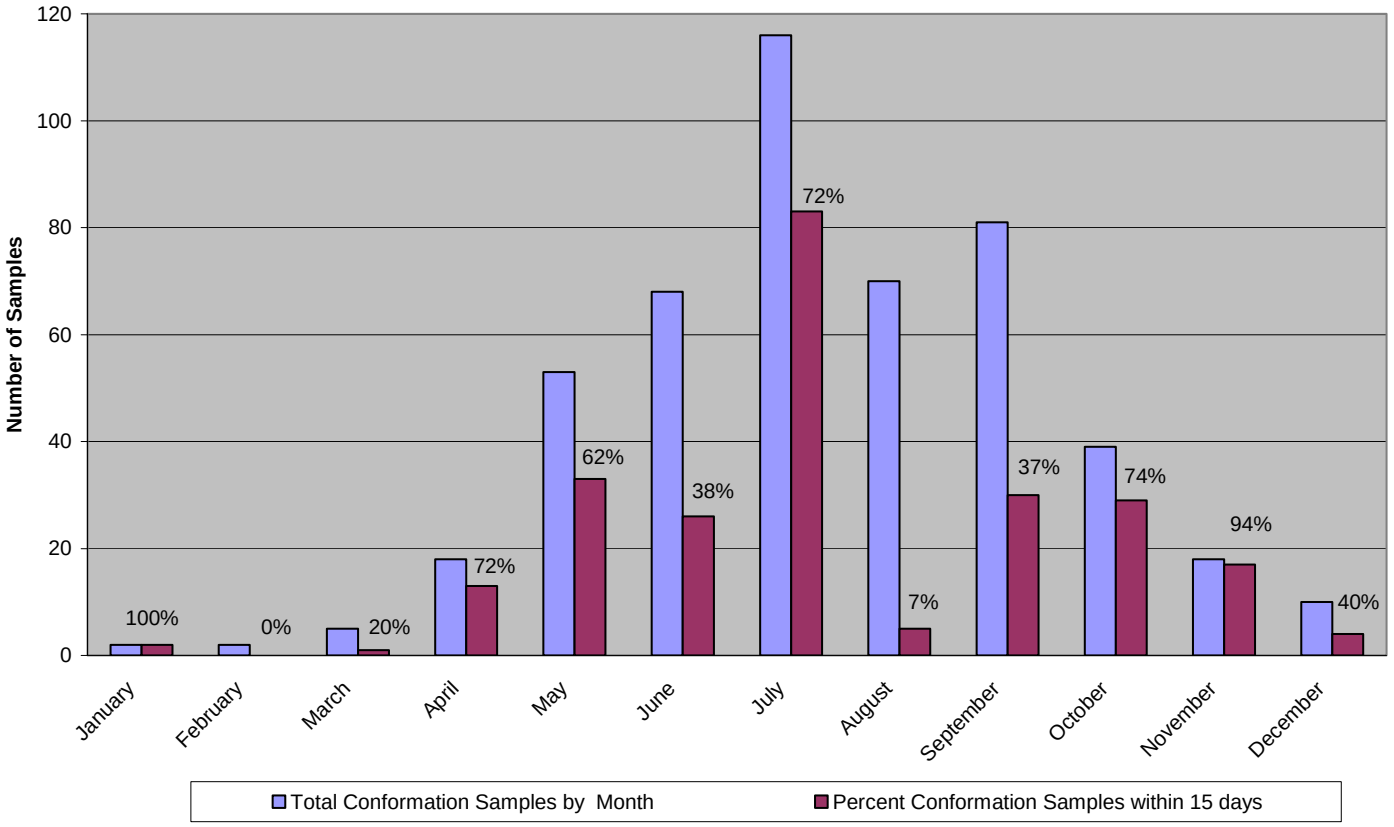
- Workload in the Bituminous Materials Section
- FTE's
- Equipment and space
- Overtime authorization
- Project Engineer delays

In 2008, the Bituminous Materials Section tested 491 HMA mix design conformation samples. The average time of completion for these samples was 17 calendar days. The Bituminous Materials Section established a goal of 15 calendar days for the 2008 construction season based on the 2007 average of 16 days.

The most challenging time of year to maintain the 15 day completion is between August and September. This can be attributed to an increase in mix design verification testing, which has a 25 calendar day maximum per Standard Specification 5-04.3(7)A, and the number of conformation samples received toward the end of the paving season. While conformation samples are of great importance, mix design verifications take precedence. Samples tested during December were delayed due to the PEO and needed equipment repair. To achieve the 15 day goal, mix design conformation samples will be tracked weekly and compared to the mix design verification testing. This comparison will identify the need for increased work hours helping to ensure the 15 day goal is met.


HMA Mix Design Conformation Samples 2008
Samples Delayed by PEO
Sample Delayed by PEO
2008 Average:
17 Days
2008 Goal:
15 Day Average
Days in Laboratory
HMA Mix Design Conformation Samples
0
5
10
15
20
25
30
35
40
45
50
0
50
100
150
200
250
300
350
400
450

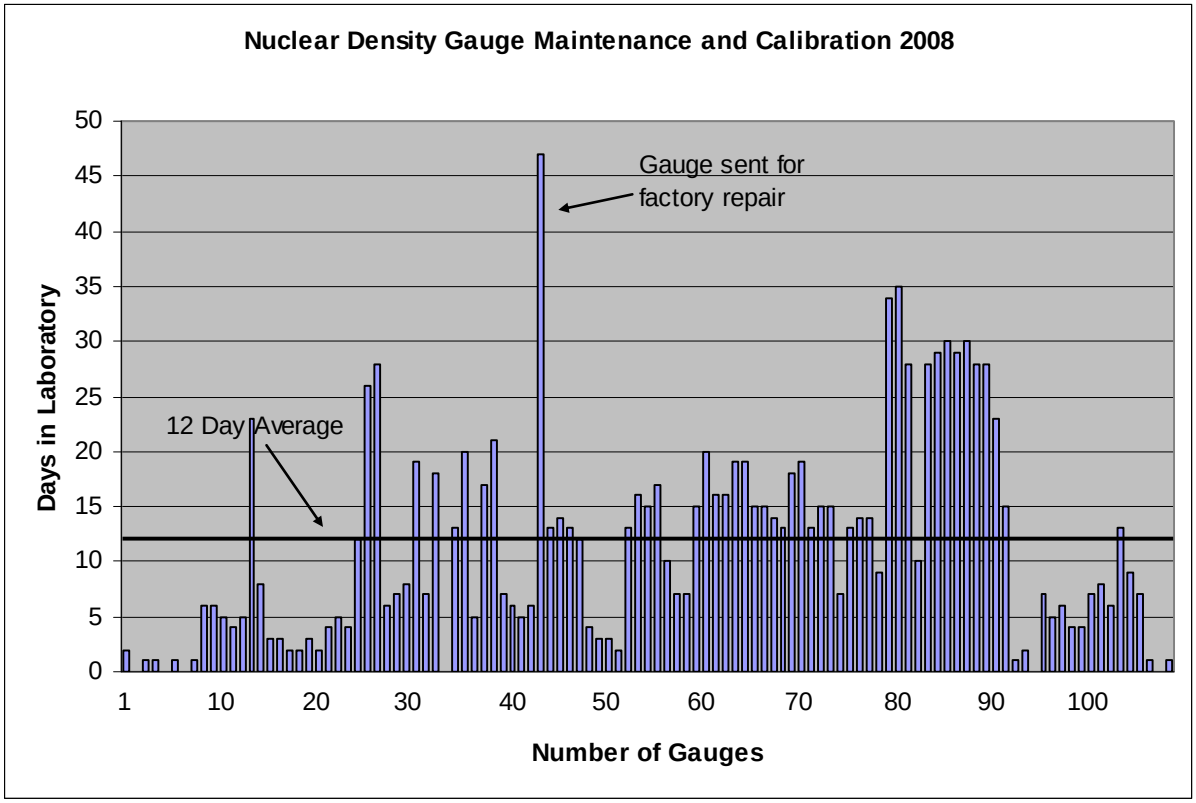
HMA Mix Design Conformation Samples 2008
Days in Laboratory By Month



Nuclear Density Gauge Maintenance and Calibration 2008

The Bituminous Materials Section, Nuclear Electronics Laboratory, performs the annual maintenance, calibration and repair of all the nuclear density gauges owned by WSDOT. Technicians with specialized training in diagnostic repair and service keep the department's one hundred and seven density gauges operating efficiently for use in acceptance of base, intermediate and surface materials. This performance measure is designed to evaluate the timely completion of the annual maintenance and calibration of WSDOT's nuclear density gauges and monitor annual efficiency.

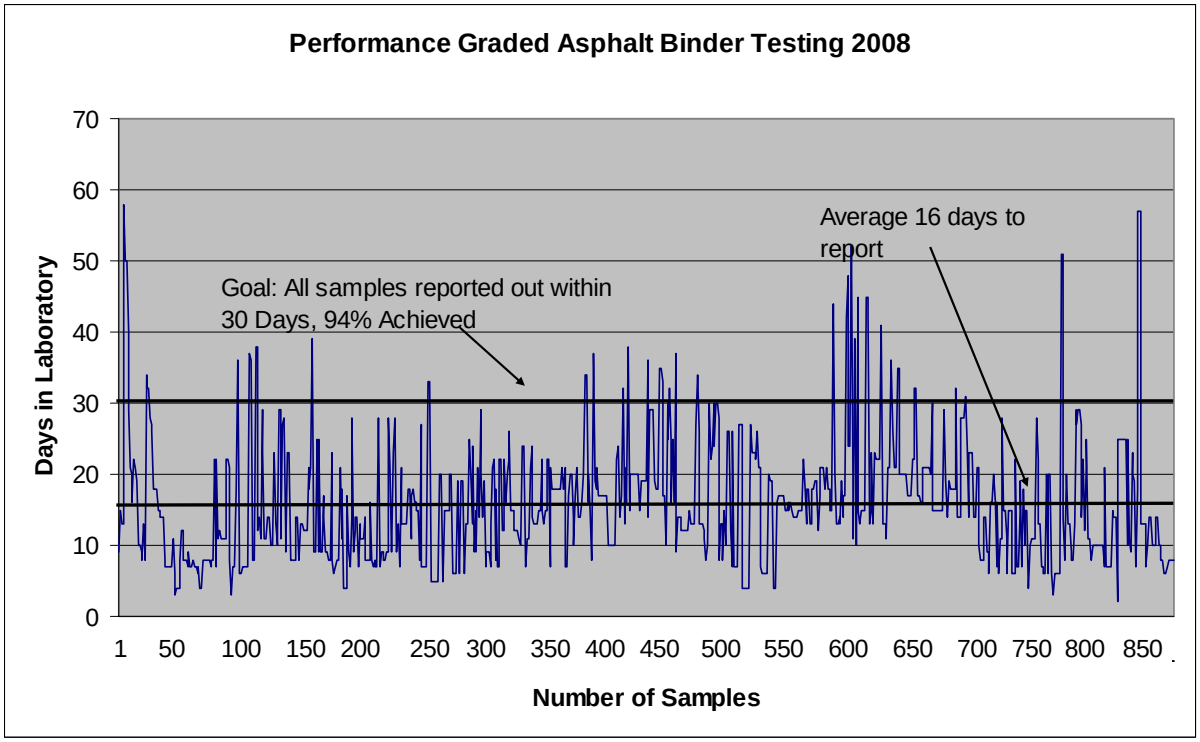
It takes approximately three months to complete the maintenance and calibration of all the gauges so this work is scheduled in the winter months when most density gauges are not in use on construction projects. The average turnaround for gauges in 2008 was 12 days. Repairs to the density gauges are performed throughout the year as needed. Performing maintenance, calibration and repair by trained WSDOT staff results in considerable time and cost savings to the department. Shipping, calibration, maintenance and repair costs would be significantly higher if this work was outsourced. The turnaround time of outsourcing this work would also impact the time sensitive testing on construction projects.



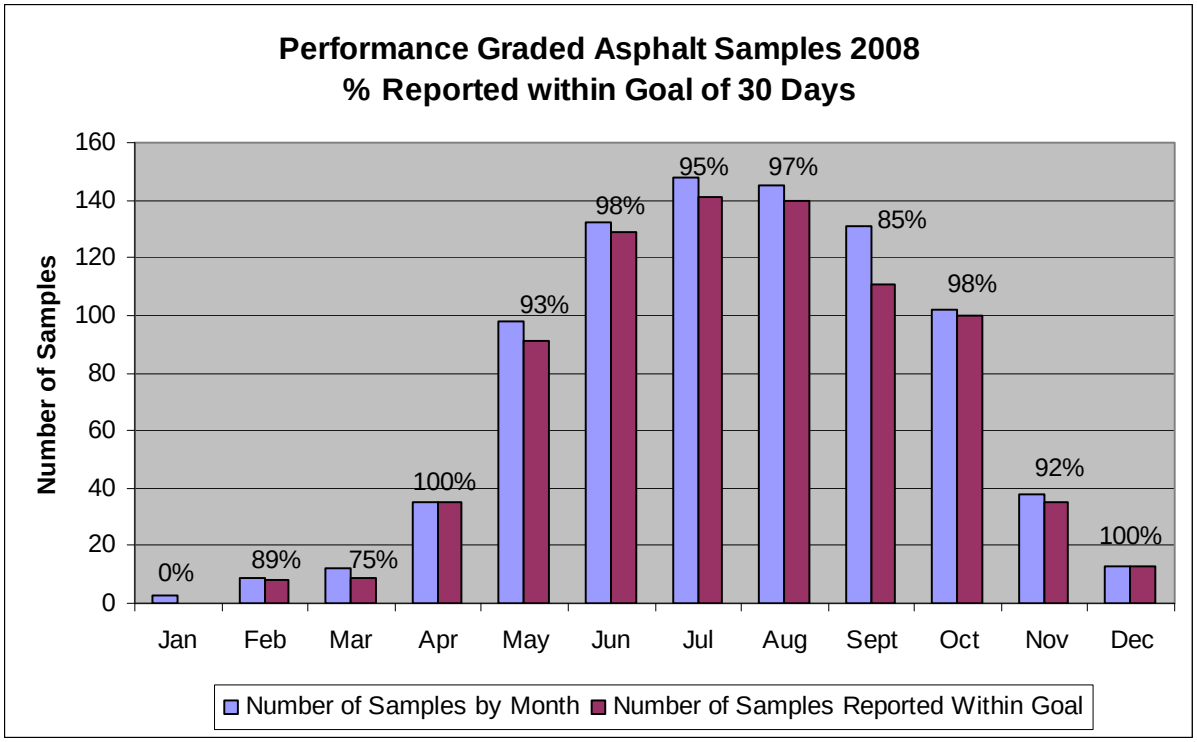
Performance Graded Asphalt Binder Testing 2008

As stated in the Construction Manual section 9-5.7 "Acceptance Sampling and Testing Frequency Guide" PG asphalt binder samples for verification are taken for every 1600 tons of Hot Mix Asphalt (HMA) produced on a construction project. A typical 1.6 million ton construction season would equate to 1,000 verification samples.

Due to the large volume of samples received during the construction season, the Liquid Asphalt Laboratory does not test all samples. For PG samples the first, third, fifth and every fifth sample thereafter are tested per contract, per supplier. If a sample does not meet specification, previous and subsequent samples are tested until the window of failure is captured. This policy brackets any failing samples, indicating the extent of the failure.



The 2008 Bituminous Materials Section goal for testing and reporting out Performance Graded Asphalt Binders is 30 days. Due to different testing temperatures used with different grades of PG binders, additional samples outside the normal testing protocol may need to be tested in order to achieve the 30 day goal.


Performance Graded Asphalt Samples 2008
% Reported within Goal of 30 Days
Number of Samples
160
140
120
100
80
60
40
20
0
0%
89%
75%
100%
93%
98%
95%
97%
85%
98%
92%
100%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Number of Samples by Month
Number of Samples Reported Within Goal

Chemistry Section Performance Measure

Testing of routine samples should be completed within the specified turn-around time that falls into three broad categories.

(1) Testing of lane markers, paint materials and fencing materials should be completed within five working days from log-in to reporting-out from the Chemistry Section as follows:

- lane markers to meet the completion time for more than 90% of the samples
- paint materials to meet the completion time for more than 80% of the samples
- fencing materials to meet the completion time for more than 70% of the samples

(2) Testing of joint materials should be completed within ten working days from log-in to reporting-out from the Chemistry Section as follows:

- joint materials to meet the completion time for more than 80% of the samples.

(3) Testing of epoxy adhesives should be completed within seventeen working days from log-in to reporting-out from the Chemistry Section as follows:

- epoxy adhesives to meet the completion time for more than 80% of the samples.

Performance in 2008

1.) Testing that was reasonably completed within **5 working days** from log-in to reporting-out from the Chemistry Section.

	2008	**2007**	**Change from 2007**
Paint	100%	93%	*7% improvement*
Fencing	100%	99%	*1% improvement*
Lane Markers	100%	91%	*9% improvement*

2.) Testing that was reasonably completed within **10 working days** from log-in to reporting-out from the Chemistry Section.

	2008	**2007**	**Change from 2007**
Joint Materials	100%	100%	*N/A*

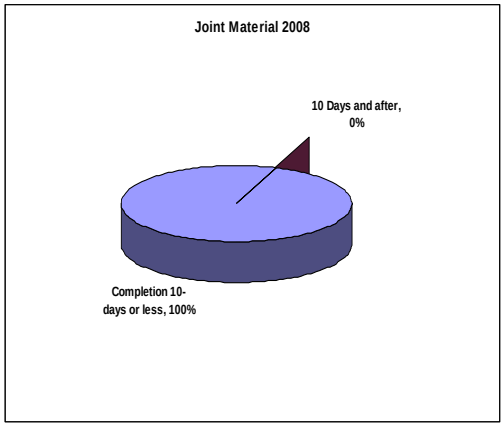
3.) Testing that was reasonably completed within **17 working days** from log-in to reporting-out from the Chemistry Section.

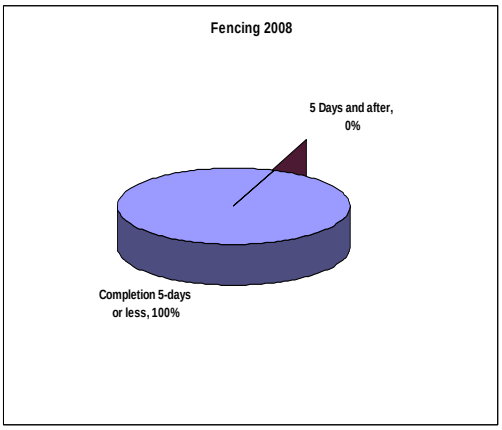
	2008	**2007**	**Change from 2007**
Epoxy	100%	100%	*N/A*

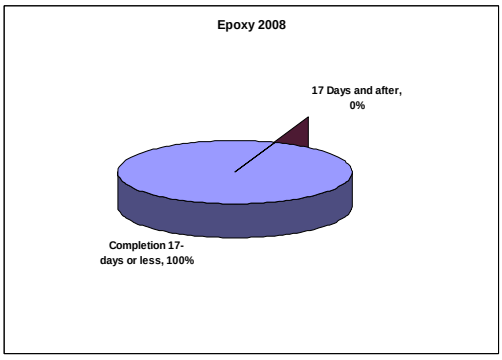
NOTE: Incomplete samples, samples with improper transmittals, and samples that require special handling, generally require longer than expected completion times.

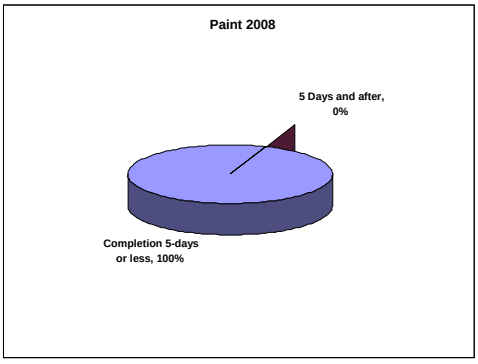
All material categories meet and exceed performance goals in 2008.

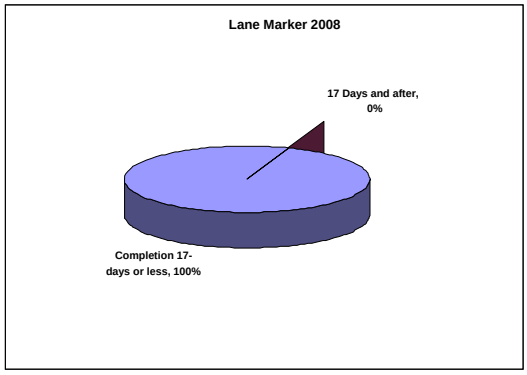
- Lane markers met the completion time performance goal for more than 90% of the samples.
- Paint and Joint materials met the completion time performance goal for more than 80% of the samples.
- Fencing materials met the completion time performance goal for more than 70% of the samples.
- Epoxy adhesives met the completion time performance goal for more than 80% of the samples.











Electrical Section Performance Measure

Traffic Controller Evaluation 2008

The attached stack bar chart titled Performance Measures 2008 represents the amount of time used for each of the traffic controller assemblies tested at the Materials Lab from 9/30/2007 to 10/1/2008. The total length of the bar represents the total time the controller assembly was resident at the lab for testing. The bar is divided into two sections: the upper section represents the amount of time used by the lab to complete the evaluation of the controller assembly: the bottom section represents the amount of time spent waiting for the vendor to correct problems discovered during the evaluation.

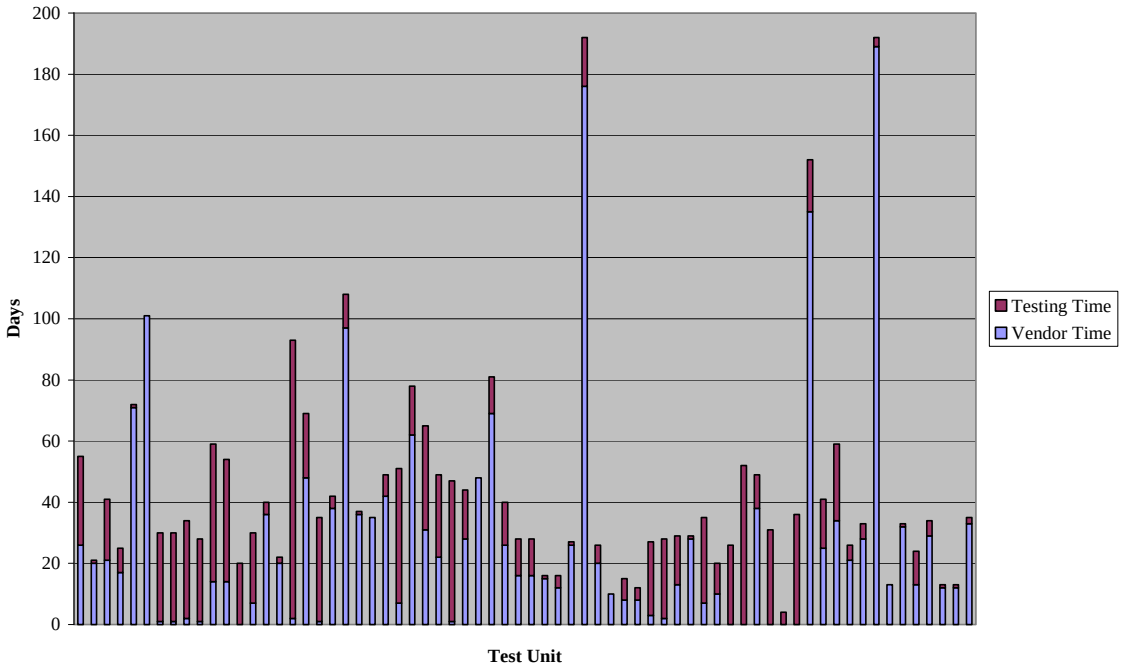
The average number of days required to complete the evaluation of a traffic controller assembly for the period of 9/30/2007 and 10/1/2008 was 44 days, as compared with 38 from the previous reporting period. During the same reporting period the average Vendor Delay dropped from an average of 31 days to an average of 28 days while the average Test Time was 17 days. Presented in the following table are the statistics of each of the distributions: Total Time, Vendor Delay, and Test Time, for 2006, 2007 and 2008.

Year	2006			2007			2008		
days	Total Time	Vendor Delay	Test Time	Total Time	Vendor Delay	Test Time	Total Time	Vendor Delay	Test Time
Average	33	25	9	38	31	7	44	28	17
Max	104	87	41	99	96	32	192	189	91
STD	21	21	9	22	22	7	35	36	16

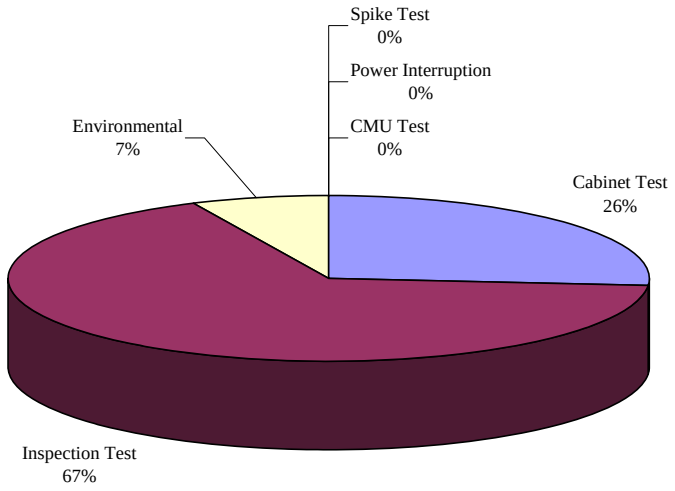
In an analysis of the data used in the chart the average total time climbed to 44 days from the 38 shown for year 2007. The increase in average total time is explained by the increase in testing time. The increased test time is because of a testing back log created by the erratic distribution of cabinet deliveries, together with the changes in project requirements. In this past year some adjustments to the testing queue were made based on a project need delivery date. The goal for this next year will be the same as last year, to not let the total time go past 29 days, in addition the “first in; first out” priority system will be observed more precisely.

During the reporting period of 9/30/07 to 10/1/08 a total of 71 traffic controller cabinet assemblies were tested. There was a total of 306 nonconforming items identified while testing the 71 cabinets. The chart titled “Vendor Quality Performance” shows the distribution of the nonconforming items with respect to the test that identified the nonconforming item. This chart is included to provide information on the continued tracking of nonconforming items seen during traffic controller assembly testing. The most interesting feature about the chart is that more than 93 % of the identified nonconforming items continues to be found with a simple inspection and wiring test.

Performance Measures
2008



VENDOR Quality Performance
2008



Construction Materials Administration

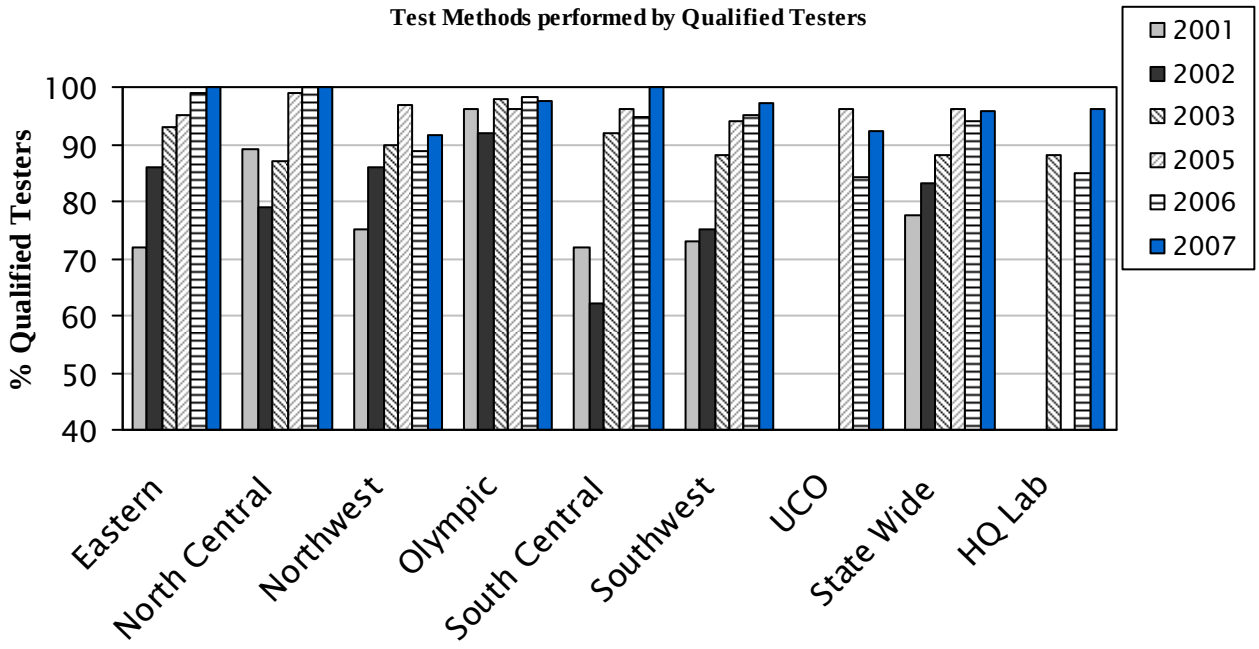
WSDOT Qualified Tester Program

On June 25, 1995, the Code of Federal Regulations (CFR) changed to require all State Transportation Departments working on the National Highway System (NHS) to have Qualified Testers and Verified Equipment. Further, State Departments of Transportation were required to have their Central Materials Laboratory accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program (AAP).

Washington State Department of Transportation (WSDOT) State Materials Laboratory received AASHTO Accreditation on July 1, 1996 and has maintained its accreditation on an annual basis. WSDOT developed and implemented a Qualified Tester / Verified Equipment program which was approved by the Federal Highway Administration (FHWA) in May 1997.

Full implementation of the program occurred in June of 2000 per the CFR requirement. To measure the performance of the Qualified Tester Program, WSDOT State Materials Laboratory conducted a statewide audit in 2001. The results of the audit showed that 77.6% of acceptance tests were being performed by qualified testers. After reviewing the results WSDOT implemented a yearly audit of all construction projects with the goal of reaching 100% qualified testers performing all testing for WSDOT projects. This included all testing done by the State Materials Laboratory, Region Central Laboratories and Construction Project Engineer Offices.

Our most current audit was performed in 2008 for the 2007 construction season. The chart below shows the progress since 2001.



The key to the continuing improvement in the program is that top management has recognized the value of the Qualified Tester Program and has required qualified testers on all contracts. Management has also provided funding, time and equipment to support the program.

The success of the Qualified Tester Program is also dependant on the work of the Independent Assurance Inspectors (IAI's) in each Region and the cooperation of the Project Engineers Offices (PEO's). The PEO's have the responsibility of providing field training for new testers through mentoring by experienced qualified testers. The mentoring program provides new testers with the education in procedures they need before taking the qualification exams. The IAI's role is to provide expert testing support to the Project Offices and qualify the testers through written and hands-on testing.

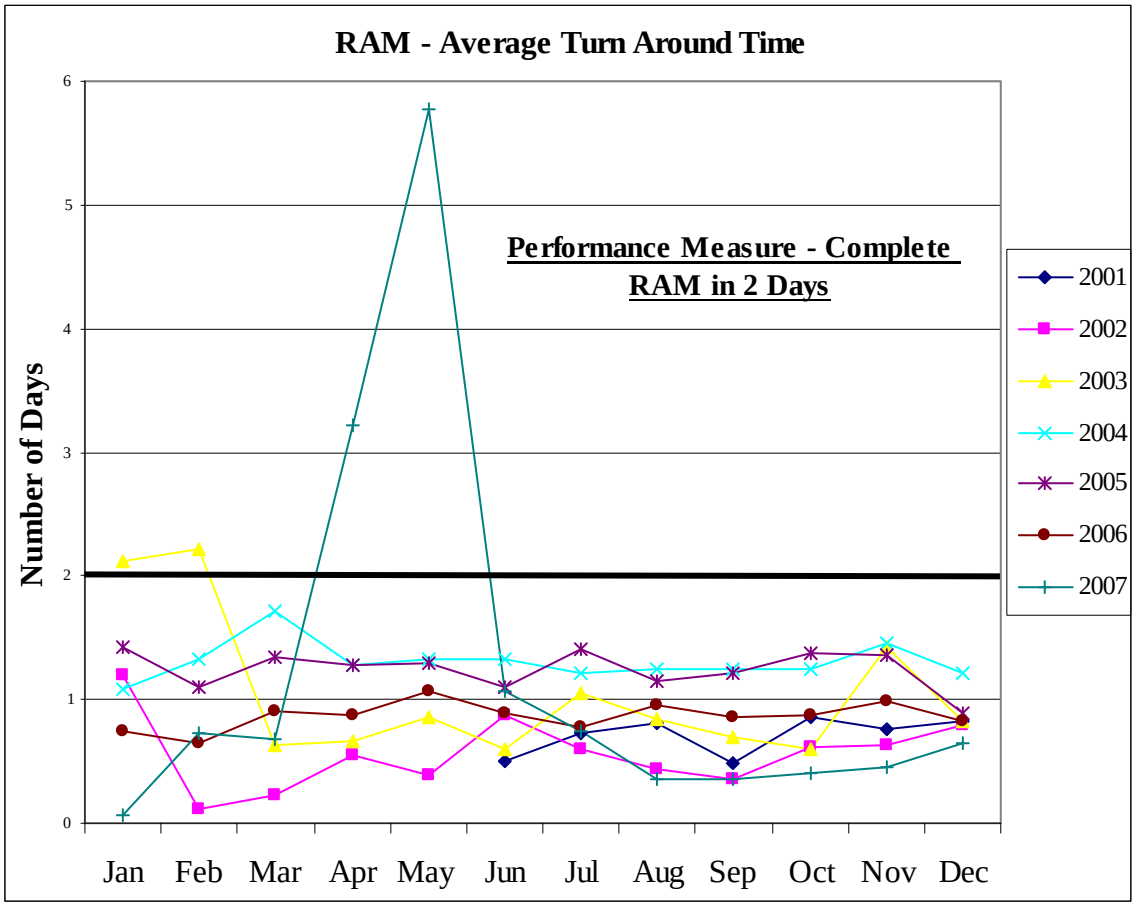
WSDOT continues to strive to meet its goal of 100% qualified testers performing the testing on WSDOT projects. Three Regions were able to achieve that goal in 2007. Once the 100 % compliance goal is met the next challenge will be to maintain that level of compliance.

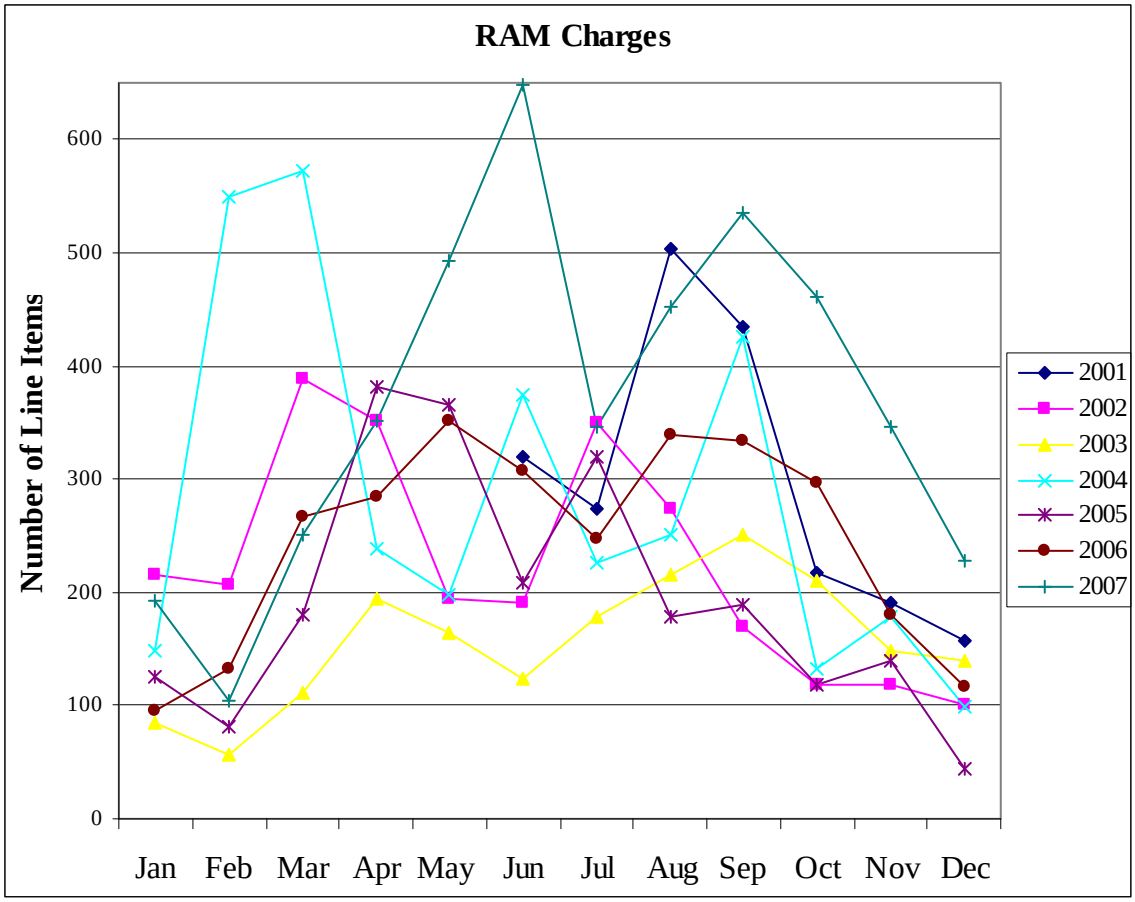
Performance Measure for Request for Approval of Material

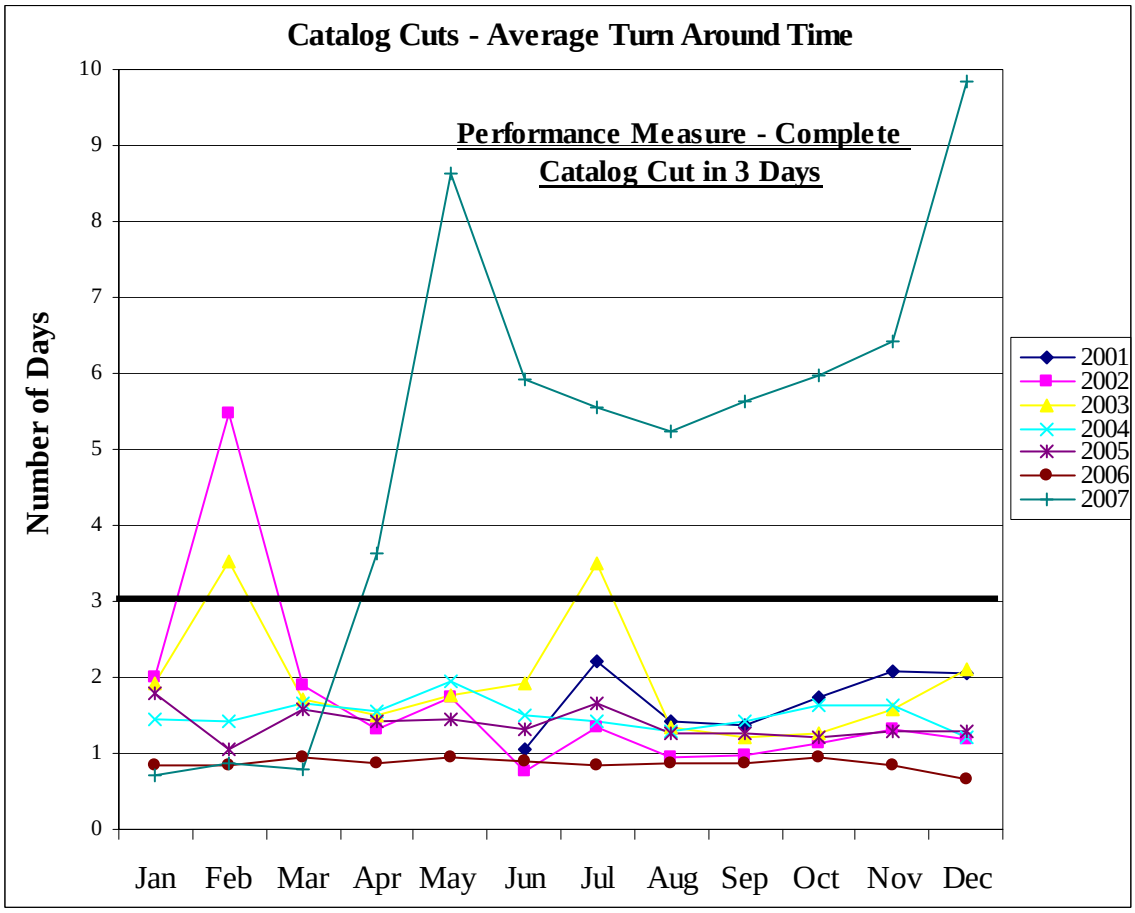
A Request for Approval of Material (RAM) is prepared by the Contractor and submitted to the PEO (Project Engineer's Office) for each product or material anticipated for use on a construction project. The purpose of a RAM is to approve a product or material prior to it being placed on a construction project. Depending on what is known about the product or material, testing may be done to determine if the product or material meets the requirements of the contract. In certain instances additional information is needed to review a product or material for approval. The review of Catalog Cuts is a method of verifying, for approval, products within the RAM process.

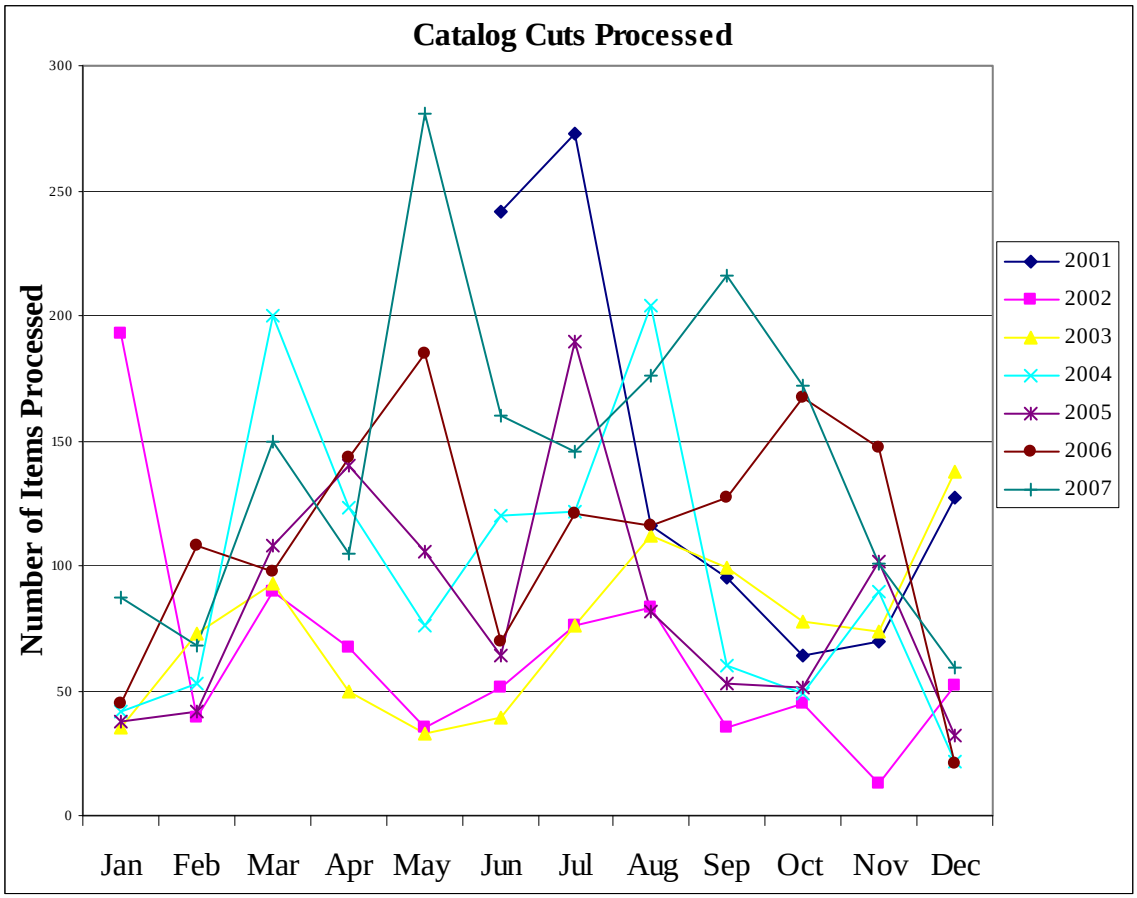
The RAM or Catalog Cut is processed by the PEO and forwarded to the Materials Laboratory Documentation Section when the Project Office has insufficient information to approve the product or material. An alternate to submitting a RAM could be choosing a product or material already evaluated and approved via the QPL (Qualified Products List) process.

The Documentation Section's Goal is to complete all RAMS and Catalog Cuts within two days of receiving the RAM. The performance goal was developed based on past turn around time for processing each RAM. Prior to approving a material or product on a RAM and Catalog Cut we often will need to consult with various Subject Matter Experts within WSDOT to gain concurrence to use the product or material. RAMs that must be sent to WSDOT's SMEs may take longer to process.




RAM Charges
Number of Line Items
0
100
200
300
400
500
600
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2001
2002
2003
2004
2005
2006
2007


Catalog Cuts - Average Turn Around Time
Performance Measure - Complete Catalog Cut in 3 Days
Number of Days
0
1
2
3
4
5
6
7
8
9
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2001
2002
2003
2004
2005
2006
2007

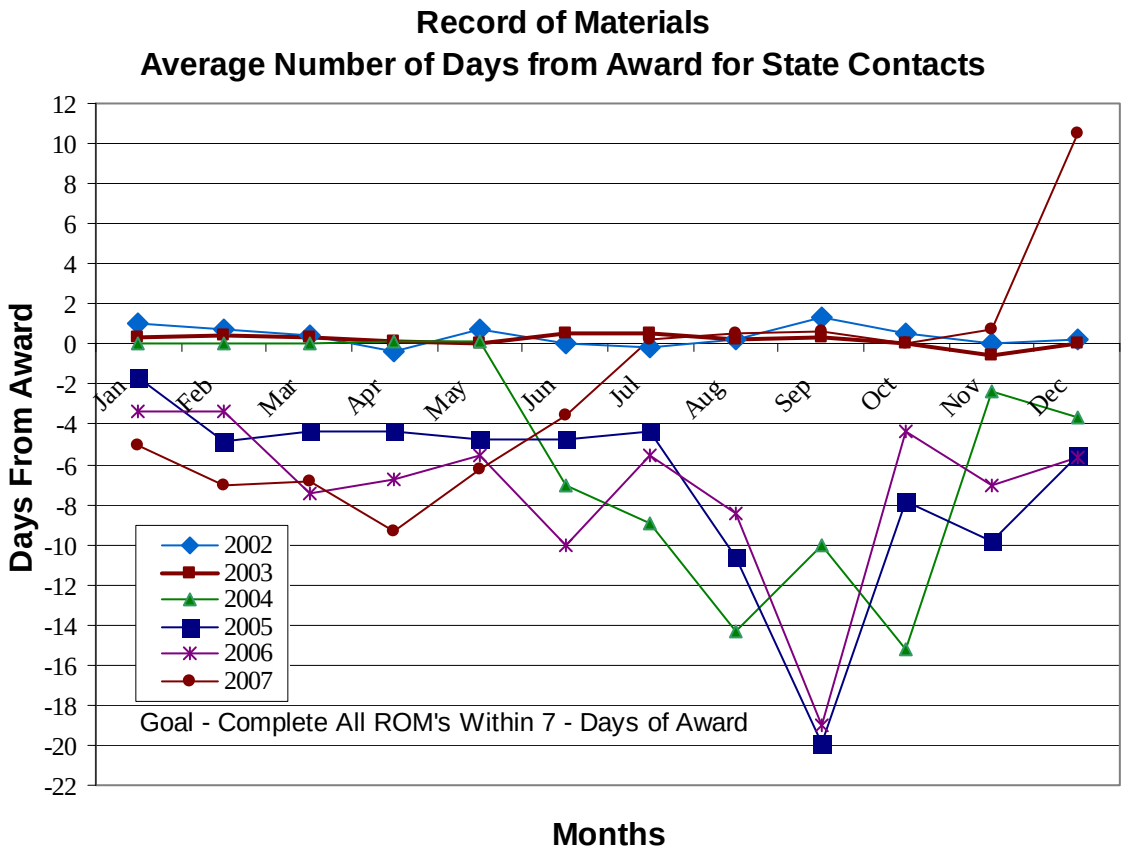


Performance Measure for Record of Materials

A Record of Materials (ROM) is prepared by the Materials Laboratory Documentation Section for every WSDOT construction contract and many local agency construction contracts. The ROM report is a list of all major construction items intended for use on each specific contract, taking into account the contract which includes Contract Provisions, Contract Plans, Standard Specifications, Construction Manual, Standard Plans and the quantities of those materials deemed to require acceptance testing. It further identifies the minimum number of acceptance and verification samples required for acceptance of those materials, with reference to total quantities and respective specification criteria. Also listed are products requiring other actions, such as fabrication inspection, manufacturer's certificate of compliance, shop drawings or catalog cuts that may need to be performed or acquired prior to installation of each material in the field.

The ROM is processed by the Documentation Section and forwarded electronically to every Project Office or appropriate Local Agency. The office administering the construction project can then provide this information to the Contractor and/or use it themselves to determine appropriate testing frequencies and acceptance criteria for each material or product used on the project.

The Documentation Section's goal is to complete the ROM within seven days after the contract is awarded. The performance goal was developed based on feedback from regional personnel and the necessity to wait as long as possible to allow for incorporating any last minute addendum that may apply to the contract.



Performance Measure for Compliance Reviews

As part of the WSDOT's Stewardship Agreement with the FHWA, the WSDOT is required to review contract compliance in the materials documentation area, these compliance reviews are a "spot check", verifying compliance with WSDOT's materials documentation requirements. The Materials Documentation Section of the State Materials Laboratory has been tasked with conducting Compliance Reviews and acting as unbiased auditors verifying contracts meet materials documentation requirements.

The requirements are covered in the WSDOT Construction Manual 9-1.5, Material Certification - Compliance Review for Materials Certification Process. A Compliance Review is performed on at least one contract for each project office once every two years. The reason Compliance Reviews are performed is to review previous materials documentation, assist Project Offices in maintaining adequate materials acceptance practices for future contracts, and to be proactive in initiating possible changes to the Construction Manual and Standard Specifications.

The Compliance Review findings are discussed with Project Office personnel during the wrap-up meeting after the review. A final letter covering the compliance review findings is then prepared and shared with WSDOT and the FHWA to document the Compliance Review findings.

Tracking and Charting Compliance Reviews

Each item reviewed during the Compliance Review is evaluated, tracked, and charted in the following areas.

- Field Verification

Was the material verified in the field by the inspector for what material was approved to be used by the RAM/QPL and proper acceptance criteria?

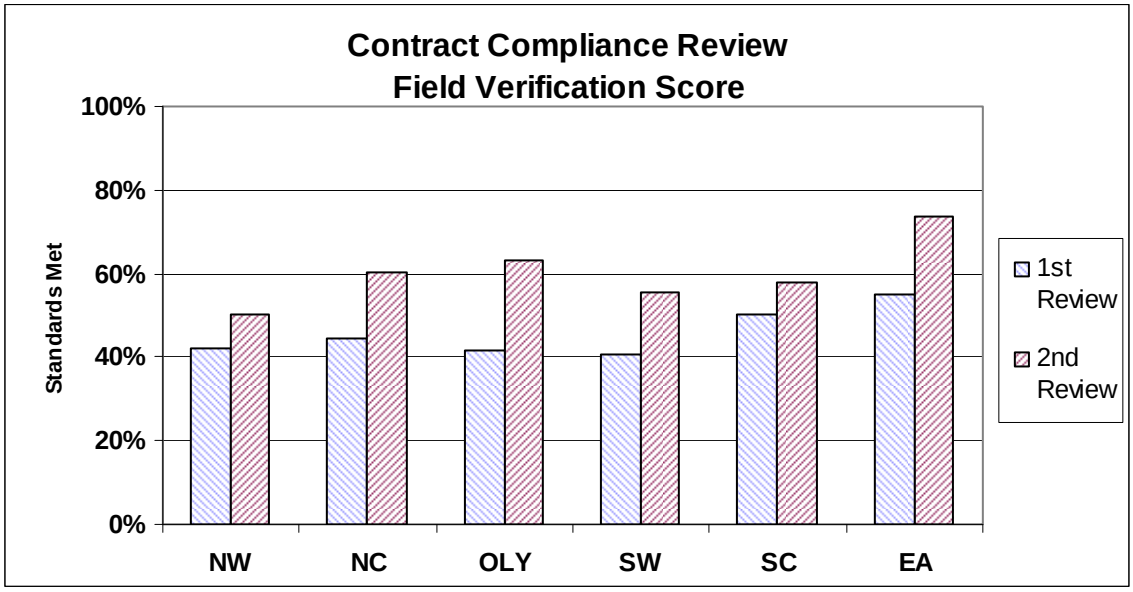
- Office Materials Documentation Score

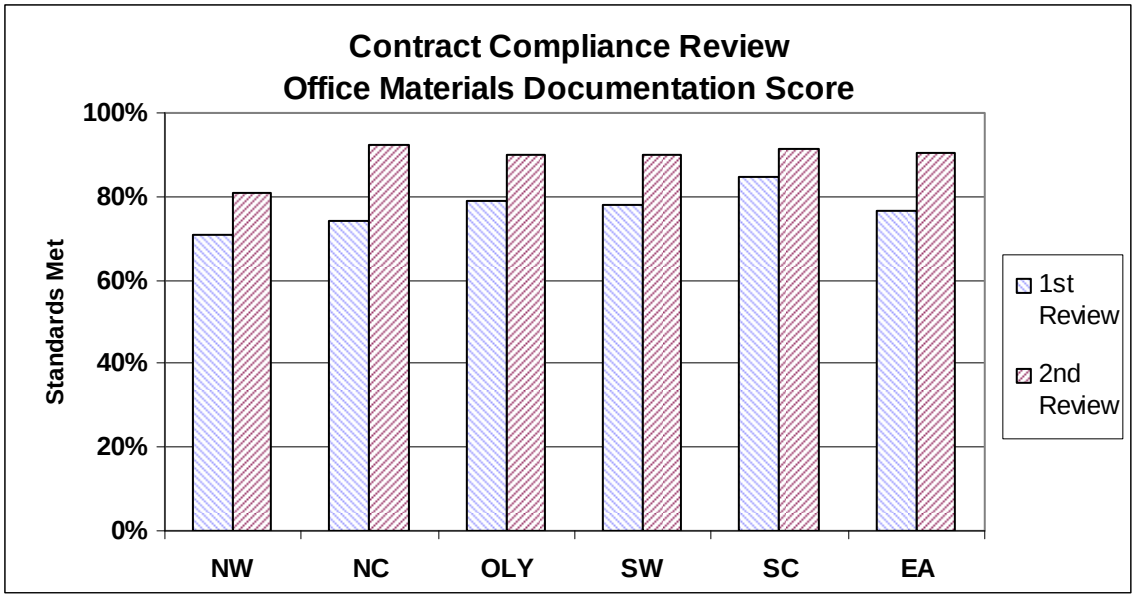
  Each criterion mentioned below counts 25% of the Office Materials Documentation Score.

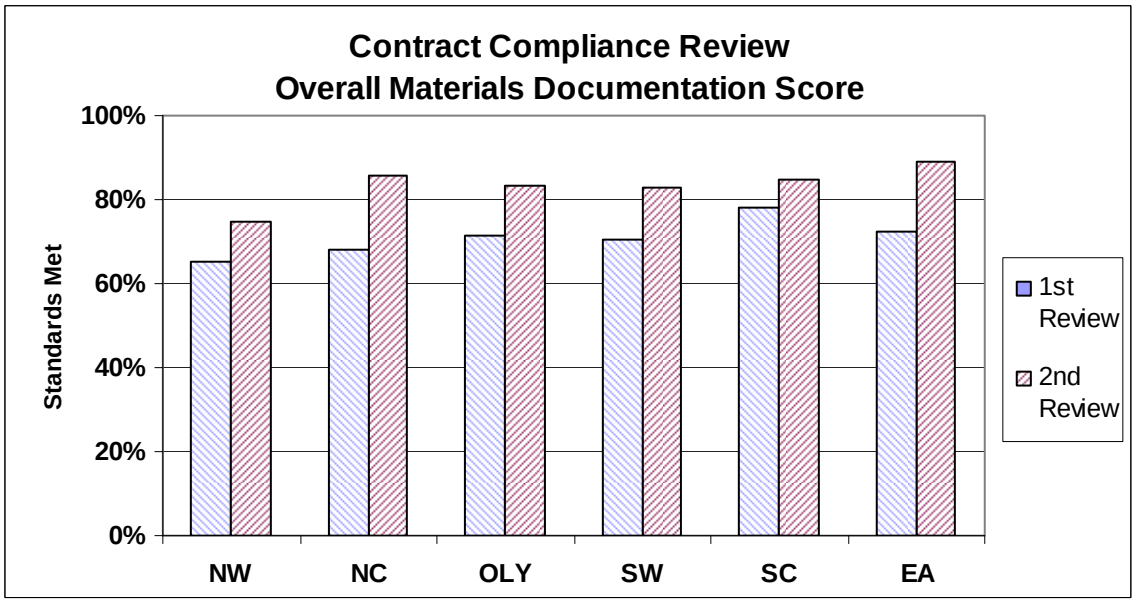
  - Were the Pay Ledger and Field Note Records consistent for materials paid?
  - Was the maintained ROM (tracking program) being kept up for quantity used, proper materials acceptance, and other documentation requirements as needed per 9-1.5 and 9-1.5A of the Construction Manual?
  - Was a RAM or QPL used prior to material placement and used correctly per 1-06.1 of the Standard Specifications and 9-1.5B of the Construction Manual?
  - Was the proper acceptance criteria received and approved prior to placement, i.e. Acceptance Sample, Catalog Cut, Manufacture Certification of Compliance, Approved for Shipment 'Tag' or 'Stamp' or Shop Drawing per the Standard Specifications, Standard Plans, Construction Manual and the Contract Specials and Plans?

- Overall Materials Documentation Score

  The four parts of the Office Materials Documentation Score are added to the Field Verification Score and then divided by "5".




Contract Compliance Review
Office Materials Documentation Score
Standards Met
100%
80%
60%
40%
20%
0%
NW
NC
OLY
SW
SC
EA
1st Review
2nd Review


Contract Compliance Review
Overall Materials Documentation Score
Standards Met
100%
80%
60%
40%
20%
0%
NW
NC
OLY
SW
SC
EA
1st Review
2nd Review

Construction Materials Structural

Materials Fabrication Inspection Performance Measure

Crosshole Sonic Logging Testing (CSL)

The Materials Fabrication Inspection office performs all In-plant inspections for all WSDOT construction contracts for roads and bridges. 11 years ago the fabrication office started providing CSL testing to the Regional Project Engineer's office throughout the State.

The performance measure will track our response time in performing CSL testing, from the test date requested by the Project Office to the date of actual testing. The goal is to respond no later than 48 business hours from the test date requested.

This information will be used to track our efficiency in responding to the project engineer's office request for CSL testing and also maximizing the scheduling of in-plant inspection of our inspectors.

These Performance Measure charts and graphs illustrate the relationship of CSL testing date, as it relates to request dates for CSL testing. They are divided into:

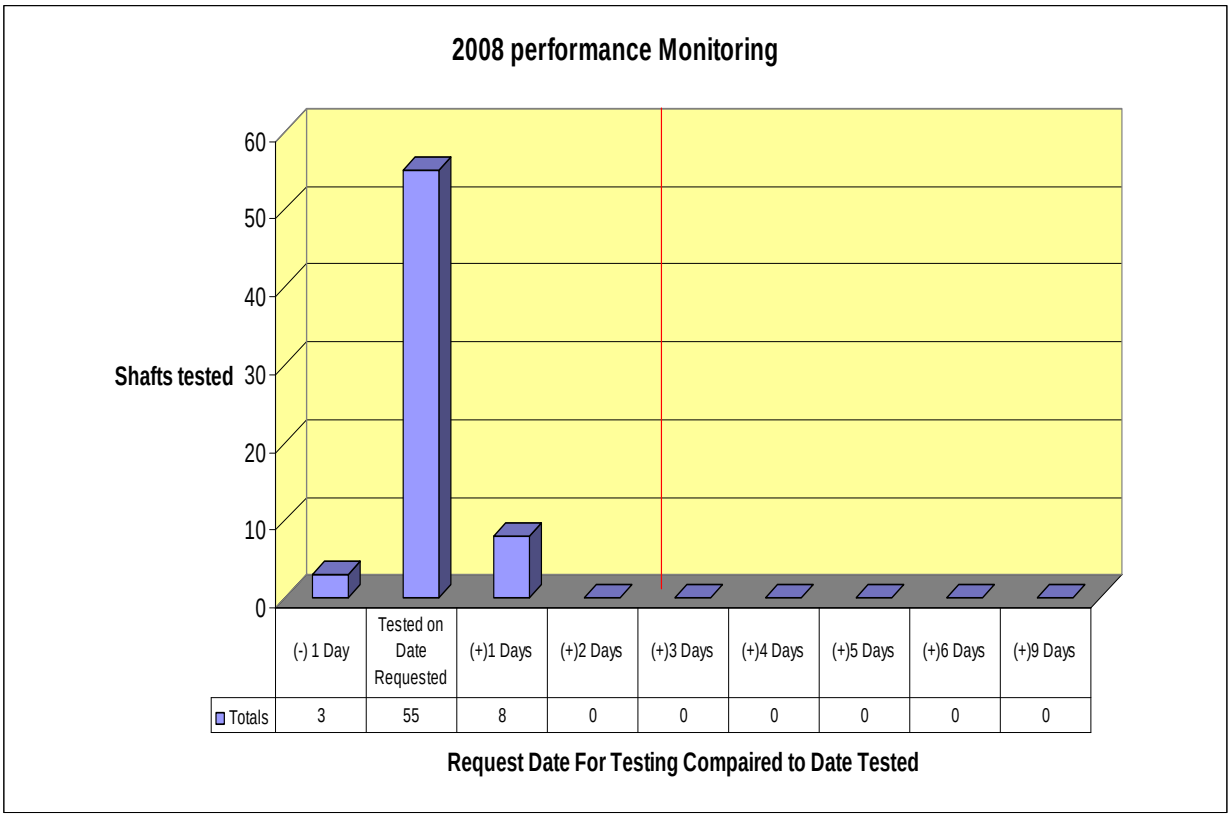
- Breakdown: Shows all test locations and the date tested under the number of business days since the date requested for testing.

- Notification: Table of number of days from date request for testing until testing with corresponding graph.

- Comparison: Compares cumulative percentage of annual testing from 2005 to 2007, broken down from the request date until actual date tested.

Crosshole Sonic Logging Performance Monitor 2008

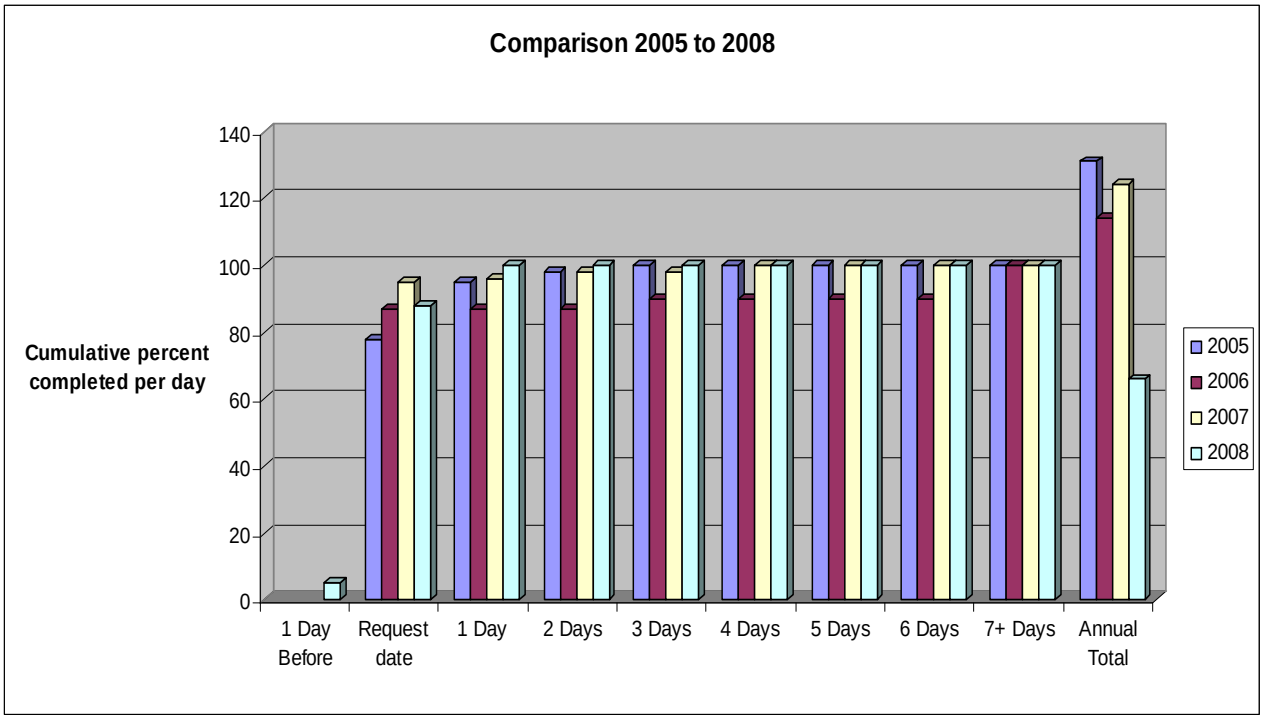
A total of 66 shafts were tested in 2008, of these all were tested within the two day specification.



The deviance from compliance with the 2 day specification is attributed to scheduling of both WSDOT and the contractor, and obtaining access to the test area after the drilling equipment has been moved.

Comparison 2005 to 2008

The cumulative percentage of the annual total testing by the number of days from the date requested until data acquisition was actually obtained. The target is for 100% of the testing to be completed no later than two days from the request date for testing.



	2005	2006	2007	2008
1 Day Before				5
Request date	78	87	95	88
1 Day	95	87	96	100
2 Days	98	87	98	100
3 Days	100	90	98	100
4 Days	100	90	100	100
5 Days	100	90	100	100
6 Days	100	90	100	100
7+ Days	100	100	100	100
Annual Total	131	114	124	66

This year all of the shafts tested were within the 2 Day specification.

Geotechnical Performance Measures

Productivity Measures

The Geotechnical Division provides statewide geotechnical (foundation engineering and engineering geology) design, construction, and maintenance support services for WSDOT. For performance measurement purposes, The Division's services can be subdivided into three primary functions, which include field exploration services, geotechnical design services, and P3 program unstable slopes technical management.

An important measure of our service to the Region offices, the Marine Division, the Bridge Office, the Office of Program Management, and other key customers statewide is how well we keep our commitments regarding costs and completion time. For geotechnical design, this measure has been accomplished by tracking the number of design hours to complete the geotechnical portion of a project, and comparing that value to the hours estimated for the project. In 2007, however, the performance measure for geotechnical design was switched to design cost. Similarly, for field exploration, tracking the field exploration cost to complete the geotechnical field investigation for a project, and comparing that value to the field exploration cost estimated for the project accomplish this measure.

Another measure of productivity that can be applied to the Field Exploration activities is the cost per foot of test hole drilling. The cost per foot is dependent on a number of factors, including:

- the type of drilling equipment used,
- the travel distance and difficulty encountered in getting the drilling rig to the test hole location,
- the nature of the soil/rock encountered during the drilling (e.g., bouldery soils are much more difficult to drill through than uniform sands and silts), and
- the productiveness of the drill crew.

Therefore, comparisons must be made for similar equipment in similar drilling and access conditions.

Performance measures have been in place for the Geotechnical Division since the latter half of 2001. Since 2006, due to changes in how the Division is tracking geotechnical design projects, the previous years' statistics are not provided. For 2007 and 2008, comparisons between the estimated and actual (billed) costs needed to complete a project geotechnical design are provided in Figure 1. A ratio (costs billed/estimated costs) of 1.0 means that the estimated costs and the billed costs are the same. A ratio less than 1.0 indicates the project was completed at a lower cost than estimated, which is desirable, provided that the estimate was not too much higher than the actual amount it took to get the job completed. A ratio greater than 1.0 indicates that billed costs were greater than estimated, which is undesirable. Our target is to have the estimate within 20% of the actual costs. If a change in scope for the project occurred after the final estimate was made, the estimate was revised only if the revised estimate was communicated to the region in advance, as soon as the change in scope was known.

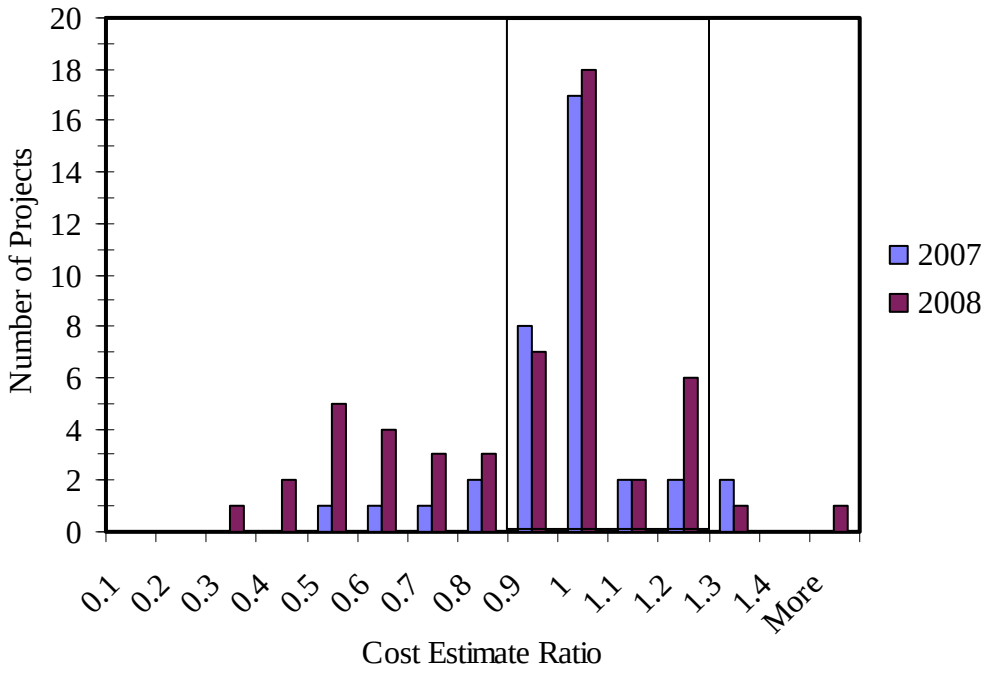


Figure 1. Ratio of billed costs to estimated engineering costs for geotechnical projects completed in 2007.

The number of projects that overran the estimate by more than 20% was only 6% of the total for 2007 and 4% for 2008 (36 projects which had an initial cost estimate were completed in 2007, which is similar to the total number of projects completed each year since 2004, and 53 projects which had an initial cost estimate were completed in 2008). In previous years, based on estimated versus actual (billed) hours, the percent of projects that overran the estimate by more than 20% was typically around 20%. Overall in 2007, the percent of projects that overran or under-ran relative to the estimated project cost by more than 20% was 19%, but in 2008, this increased to 38%. In previous years, based on estimated versus actual (billed) hours, the percent of projects that overran or under-ran the estimate by more than 20% was typically around 40%. While a direct comparison to previous years cannot be made, in general the statistics for 2007 appear to be a strong improvement, at least with regard to overrunning project cost estimates. However, these statistics also show that the majority of projects in 2008 were significantly overestimated in terms of cost. Apparently, the Geotechnical Division's engineering estimates have started to get a little too conservative. This issue will be further investigated in 2009.

Figure 2 provides a comparison between the estimated and actual (billed) costs needed to complete the field exploration for a design project. A ratio (costs billed/estimated costs) of 1.0 means that the estimated costs and the billed costs are the same. A ratio less than 1.0 indicates the project field exploration was completed for less cost than estimated, which is desirable, provided that the estimate was not too much higher than the actual amount of time it took to get the job completed. A ratio greater than 1.0 indicates that more cost was billed than estimated, which is undesirable. Our target is to have the estimate within 20% of the actual cost.

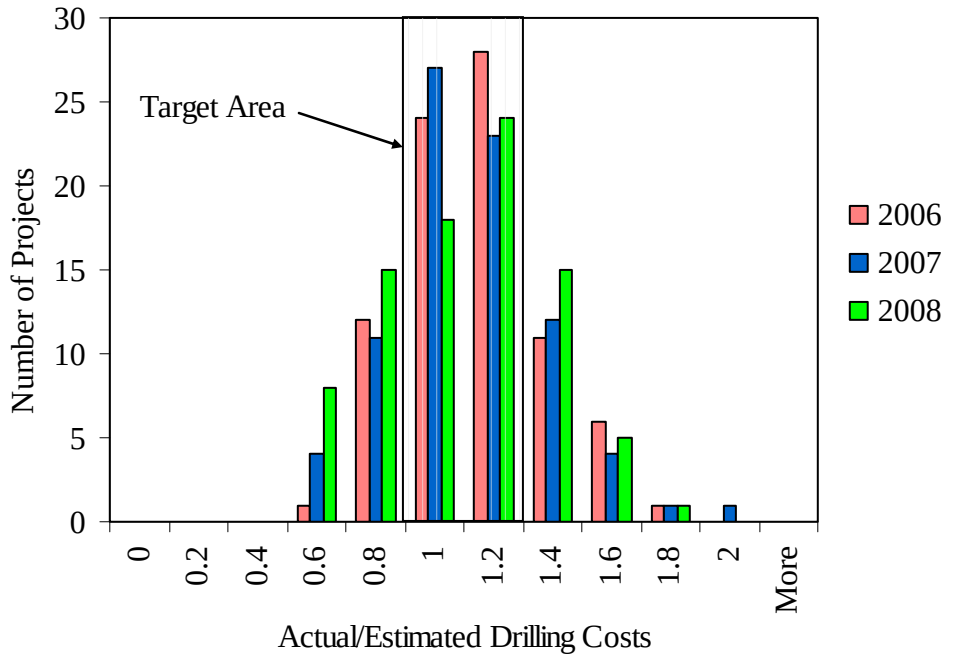


Figure 2. Ratio of billed costs to estimated costs for geotechnical field exploration services completed July 2006 through December 2008.

For the sake of readability, only the data for years 2006 through 2008 are provided. However, Table 1 (below) summarizes the key statistics that illustrate the drilling cost prediction accuracy from 2001 to 2008.

Table 1. Summary of drilling project estimate statistics.

	2001 (last half)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Total Number of Projects	8	74	93	82	71	83	83	86
Projects Outside of 20% Target Range (% of total)	38%	39%	37%	37%	32%	37%	40%	51%
Projects More Than 20% Over Budget (% of total)	0%	25%	14%	18%	15%	22%	22%	24%

Figure 3, which shows the difference between the estimated and actual drilling costs for each project, provides a more complete picture of the nature of the overruns in the drilling costs, in that most of the significant overruns are for small projects where a $5,000 overrun makes a big difference in the ratios. Based on Figure 3, we find that 20% of the field exploration projects were significantly more than $5,000 over budget (negative numbers indicate a cost overrun) in 2006, 18% in 2007, and 26% in 2008. Just an extra day and half of drilling on a project can result in this type of cost increase, which can easily happen depending on the site conditions encountered or if equipment breakdown occurs. This is generally consistent with past years, in which 14%to 20% of the projects were more than $5,000 over budget, but it does appear that the number of drilling projects that end up over budget are creeping up a bit. The fluctuation in the number of projects over budget reflects the many uncertainties in estimating the cost of geotechnical field exploration, as discussed in more detail below. Furthermore, this fluctuation

is dependent on how aggressively the estimate is made, i.e., rather than estimating project costs conservatively, targeting greater accuracy in the estimate.

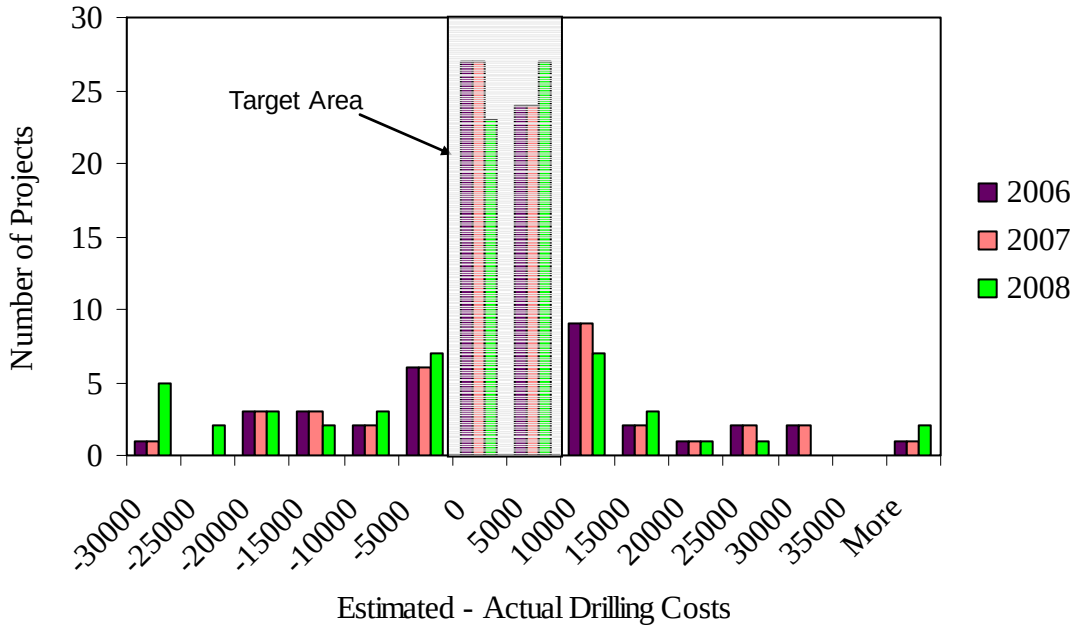


Figure 3. Estimated minus actual cost for geotechnical field exploration services completed January 2006 through December 2008.

It should be recognized that there are a lot of uncertainties in putting together estimates for geotechnical work, primarily due to the variable nature of the subsurface conditions which can affect the type and complexity of the design required, as well as the depth and number of test holes, probes, etc., needed to characterize those conditions. Scope changes during design can also affect the accuracy of the estimate. Continued improvement is needed to better track hours and cost estimates as the project progresses, and to immediately discuss the impact of any customer generated changes in scope with the customer, so that the estimate can be properly adjusted and planned for. We made some progress on this issue in 2008, but this will continue to be a goal for next year's performance. Furthermore, when a staff member gets overwhelmed with a project with complex ground conditions or overall project complexity, there is a tendency for other projects the person is working on to be delayed as well. Tracking these scope changes better and communicating them to the customer as early as possible, as well as attempting to head off the build up of delayed work earlier through redistribution of work to the staff, will continue to be a focus area in 2009 regarding our project management.

In spite of the uncertainties in estimating geotechnical design and exploration costs, these performance measures have been useful to evaluate performance of crews and units within the Geotechnical Division. These performance measures allow us to monitor crew/unit performance and track project costs better. It has increased our focus on the key aspects of the services provided by the Geotechnical Division. It has also allowed the crew/unit members to see what is expected of them and to follow their progress to completion of all projects. These tools have also proven useful to better communicate with our customers and to help develop realistic expectations regarding the scope and cost of services needed for a given project.

In the past, when criticism has been received, it has often been the result of unrealistic expectations, or poor communication between the Geotechnical Division and the customer regarding the project scope and the cost to accomplish that scope. The performance measures reported herein will continue to be used to insure that the project scope is properly assessed and communicated, and that expectations are realistic.

A benefit of these performance measures is the improved ability of Geotechnical Division managers to evaluate performance and make course corrections before problems get big and costly. This has been especially apparent when evaluating the performance of the field exploration unit. If the performance measures and their use by management are effective, cost decreases to deliver services should occur as inefficiencies are reduced or eliminated. Tables 2, 3 and 4, which provide the unit cost per ft of test hole drilled (field exploration services), illustrate this point:

Table 2. Summary of average drilling costs for 2002 through 2004.

Type of Drill Rig	Average 2002 Cost/ft of Drill Hole			Average 2003 Cost/ft of Drill Hole			Average 2004 Cost/ft of Drill Hole		
	No. of Holes	Drill Footage (ft)	Cost/ft	No. of Holes	Drill Footage (ft)	Cost/ft	No. of Holes	Drill Footage (ft)	Cost/ft
All Rigs and Projects	362	17,166	$124.62	567	20,943	$114.20	689	29,357	$99.38
Track Mounted 850 Rig	60	2,771	$84.55	81	3,276	$116.76	104	4,733	$85.54
Truck Mounted Rig	67	2,259	$103.35	57	2,146	$97.35	49	1,134	$104.12
Skid Rig	40	1,818	$133.19	54	2,284	$136.30	43	1,770	$115.57
Barge Rig	24	1,952	$174.94	11	699	$108.36	26	2,030	$116.52
Multiple Rig Type Project	154	7,222	$149.91	334	11,576	$123.82	388	16,466	$106.14

Table 3. Summary of average drilling costs for 2005 and 2006.

Type of Drill Rig	Average 2005 Cost/ft of Drill Hole			Average 2006 Cost/ft of Drill Hole			Average 2007 Cost/ft of Drill Hole		
	No. of Holes	Drill Footage (ft)	Cost/ft	No. of Holes	Drill Footage (ft)	Cost/ft	No. of Holes	Drill Footage (ft)	Cost/ft
All Rigs and Projects	856	44,486	$90.91	826	43,893	$91.20	946	49,015	$91.93
Track Mounted 850 Rig	35	1,791	$66.71	38	2,246	$80.80	91	3,606	$105.04
Truck Mounted Rig	23	498	$81.44	41	2,174	$99.32	10	318	$89.20
Skid Rig	66	4,346	$121.57	29	2,247	$171.08	32	1,158	$123.47
Barge Rig	75	2,772	$121.61	3	793	$108.78	29	1,989	$192.15
Multiple Rig Type Project	662	35,620	$81.06	632	33,585	$101.12	698	38,720	$89.99
Hand tools	24	922	$9.41	83	2,848	$11.79	82	3,175	$17.29

Table 4. Summary of average drilling costs for 2005 and 2006.

Type of Drill Rig	Average 2008 Cost/ft of Drill Hole		
	No. of Holes	Drill Footage (ft)	Cost/ft
All Rigs and Projects	994	52,405	$98.95
Track Mounted 850 Rig	63	3,351	$116.68
Truck Mounted Rig	14	663	$108.41
Skid Rig	36	2,398	$139.31
Barge Rig	14	1,579	$166.79
Multiple Rig Type Project	704	37,244	$116.43
Hand tools	163	7,170	$6.44

While such comparisons on drilling costs must be made cautiously, as drilling cost for even the same rig type will be affected by the difficulty of the site subsurface conditions, traffic control restrictions, environmental permit restrictions, and variability in the difficulty and distance to mobilize the rig to the site, the general trend is that from 2002 to 2005, a significant decrease in drilling costs occurred each year. These cost decreases occurred in spite of increases during that time period in the cost recovery hourly rates that the Division must charge. These reduced per foot drilling costs have resulted in a total savings of over $1,000,000 from 2002 through 2005.

Tables 2, 3, and 4 also illustrate another point: that there is a limit in the cost decreases that can be obtained through the use of performance measures. When looking at the 2006 drilling costs per foot, it can be observed that drilling costs per foot did not decrease for the fifth year in a row. From this point forward, what is important is to consistently maintain the reduced cost per foot of drilling. It should also be recognized the recovery rates that must be charged did increase again in 2006 relative to 2005.

A major increase in the cost recovery rates occurred in 2007, primarily due to a significant increase in the base salary for technicians and engineers to catch them up to 25% below their peers in the private sector and other organizations outside of Washington state service. This resulted in an increase of 18% in the cost recovery rates by July 2007. Yet, in spite of this increase in the hourly rates, the overall cost/ft of drilling only increased $0.73 (0.8%) relative to 2006 costs, illustrating that a significant improvement in the cost effectiveness and efficiency of the WSDOT provided drilling services occurred in 2007. These continued cost decreases relative to the cost recovery rates are an exceptional accomplishment, worthy of recognition.

However, in 2008, the drilling cost per foot increased by $7.00/ft of drilling, a 6% increase in the drilling cost per foot. It does appear that the drilling cost drops over the past few years have truly bottomed out. Furthermore, a significant number of non-permanent employees have been used to fill out some of the drill crews in 2008, possibly resulting in minor reductions in the productivity of some of the crews due to the limited experience of the non-permanent employees. Now that the drill crew efficiency improvements we have seen over the years have bottomed out, fluctuations in productivity/drilling cost due to crew member inexperience, such as would

typically be the case when non-permanent employees are added to some of the crews, are more perceptible. As discussed in the next section of this report, in spite of this, the WSDOT drill crews are still extremely cost effective.

Comparison to Private Sector

For field exploration services, the drilling cost per foot can reflect the comparative efficiency of the service, provided the comparison is made between drilling projects which are similar in nature regarding the type of equipment used, the depth of the hole, the type of sampling and testing done, the drilling difficulty, and site access difficulty. This cost per foot can be used as the basis of comparison between the private sector and state forces for field exploration services, provided the conditions of project and equipment similarity mentioned previously are met. This generally requires that both the state forces and the private sector contractors be performing work almost side by side on the same project. Note also that comparisons between state forces and the private sector, on a cost per foot basis, must be made for organizations that have a similar ability to provide a variety of exploration services and to adapt to a variety of access conditions. For example, a drilling contractor who only has the ability to drill on the road (i.e., minimal off road access ability) will generally have a lower overhead cost than a contractor who has the ability to access test hole locations in any terrain conditions. The reason for this is the amount of drilling equipment that must be available for use at any time. A full service contractor simply costs more per foot of drilling than a drilling contractor who provides only limited access drilling services. Due to necessity, the Geotechnical Division Field Exploration Unit must have full service ability in all terrain conditions. A fair comparison can only be made to those drilling contractors who provide complete field exploration services at the same level provided by the Geotechnical Division.

A limited comparison between state force drilling costs and contractor drilling costs was provided in the 2001 Annual Report for the Materials Laboratory. It was found that for the few instances where a direct comparison could be made, state force drilling costs were approximately 20 to 30% less expensive than contractor drilling costs. In 2002, 2003, 2004, there were no projects available where such a comparison could be made due to reduced use of contract drillers during the period. However, since drilling costs per foot have gone down, it can be concluded that in-house drilling costs likely remained significantly below contract drilling costs. In 2005, there was one project where a direct comparison could be made, the SR-518 EB Widening Project. This project contained a lot of skid drill work. The contractor cost for their portion of the drilling was $180.01/ft, whereas the WSDOT drill crew drilling cost was only $94.69/ft. In 2006, there were three projects where such a comparison could be made. In those cases, WSDOT drilling costs ranged from 60 to just under 100% of the contractor drilling costs, averaging 75%.

In 2007, for one of the full service drilling contractors, their average cost for a series of projects with a total of 2,616 ft of drilling without the drilling inspector cost for skid or helicopter work was $219.72/ft. For WSDOT, for skid drill work, the average cost overall in 2007 without inspector costs was $79.63/ft.

In 2008, there were three projects where such a comparison could be made. In those cases, WSDOT drilling costs ranged from 46% to just over 100% of the contractor drilling costs, averaging about 75%. Specifically, the 2008 comparisons are as follows:

- **Snoqualmie Pass East/2008**: These were truck, track, skid and barge borings. WSDOT drilled a total of 1811 feet, and the drilling cost without inspector charges was $134.51/foot. The drilling contractor drilled a total of 2026 feet, and the cost of the drilling contractor without inspector charges $289.96/foot.
- **Tacoma HOV Project**: WSDOT drilled truck, track, skid and barge borings. WSDOT drilled a total of 3405 feet, cost without inspector charges $65.74/foot. The drilling contractor, using a truck and track drill, drilled a total of 3546 feet, and the drilling contractor cost without inspector charges was $90.94/foot.
- **Columbia River Crossing**: This project was all barge borings. WSDOT with skid drill and a small barge drilled a total of 858 feet, and the drilling cost without inspector charges was $137.78/foot. Two contract drillers were used in this project. The first contractor, with two skid drills and small barges, drilled a total of 2901 feet for a cost without inspector charges of $202.40/foot. The second contractor, with a large barge/tug and a truck drill, drilled a total of 2201 feet for a cost without inspector charges $123.78/foot.

While anecdotal, these examples show the cost effectiveness of the state drill crews.

For engineering services, comparisons to the private sector are more difficult to accomplish, because it is rare that state engineering forces and consultant engineering forces are working side-by-side doing similar tasks. Differences between the WSDOT Geotechnical Division and geotechnical consultants in the cost of geotechnical design services is the result of both hourly rate differences and differences in the hours a consultant may charge for a set of tasks versus the hours the Geotechnical Division would charge for the same set of tasks. Differences in the hourly rates are provided in the table below.

Consultant Task	Consultant Labor Cost	Hours	Consultant Hourly Rate(1)
AB	$63,482.00	561	$113.16
AA	$102,416.00	955	$107.24
AG	$123,812.00	1079	$114.75
AA	$46,527.00	374	$124.40
AC	$9,443.00	78	$121.06
AB	$43,300.00	329	$131.61

(1) Average hourly labor rate for all staff levels.

WSDOT Geotechnical Division average hourly rate in 2008 = $84.14
Consultant average hourly rate from table above = $115.22

Based on these recent consultant task assignments, on average, consultant rates are 37% higher than WSDOT hourly rates.

The more difficult comparison to make is in the number of ours charged to complete the tasks associated with a given project. While this comparison could be based on man-hour estimates made by the state and by the consultant independently, such estimates could be well off of what is really needed. However, the tendency is that consultant estimates are significantly higher than what the state would estimate to complete the project. Examples are as follows:

Agreement Y10213, TAD AB - SR520/I405 Seismic Study
Consultant estimate submitted - 349 hours

WSDOT independent estimate - 308 hours
Final negotiated Task Assignment amount - 329 hours
Actual amount billed by consultant once project was completed - 280 hours

Agreement Y9764, TAD CA – I90, Snoqualmie Pass East
Consultant estimate submitted - 7900 hours
WSDOT independent estimate - 3400 hours
Final negotiated Task Assignment amount - 5600 hours
Actual amount billed by consultant once project was completed – not available yet

Agreement Y9764, TAD BX – I90, Snoqualmie Pass East (GoTo Meetings for structural walls only)
Consultant estimate submitted - ??? hours
WSDOT independent estimate - 1200 hours
Final negotiated Task Assignment amount - 3386 hours
Actual amount billed by consultant once project was completed – 3386 hours

It must also be recognized that to provide proper technical oversight of the consultant's work to insure that the state's needs are met, based on long-term Geotechnical Division experience, it generally takes 1 FTE of WSDOT engineering time to oversee 4 FTE's of consultant time. This WSDOT oversight time/cost must be added on top of the consultant's total project cost.

Geotechnical laboratory testing is typically charged by the test. The table below provides a comparison to testing costs charged by geotechnical consultants.

Lab Test	WSDOT	Consultant A	Consultant B	Consultant C	Average Cost for Consultant Testing
Fine grading	$96.24	$110.00	$80.00	$85.00	$91.66
Atterberg Limits	$64.48	$120.00	$85.00	$100.00	$101.67
Consolidation plus soil classification	$481.20	$810.00	-	$635.00	$722.50
Triax – UU plus soil classification	$384.96	$610.00	-	$360.00	$485.00
Triax – CU (3 pts plus soil classification)	$577.44	$1,880.00	-	$1,635.00	$1,757.50

In general, WSDOT geotechnical testing costs charged are considerably less than what is charged by consultants for the same service. On average, with the exception of fine grading, consultant geotechnical laboratory testing costs are 26 to 200% higher than the WSDOT geotechnical laboratory testing costs charged. For fine grading, WSDOT and consultant testing costs are about the same.

Significant Programmatic Accomplishments for the Geotechnical Division in 2008

WSDOT Geotechnical Design Manual

Since its publication in September 2005, the Geotechnical Design Manual (GDM) has been in high demand from consultants, regionally and even nationally, and other state DOT's are looking to the WSDOT GDM as the basis for developing their own geotechnical design manuals, and in some cases, using it verbatim. Furthermore, the FHWA continues to promote the WSDOT GDM on their geotechnical website as a model for other state DOT's to follow.

A significant update to GDM Chapter 6 (seismic design) was completed in 2008 to update the GDM to be consistent with new AASHTO seismic design requirements approved in 2007 and published in 2008.

The manual has helped to define geotechnical design policies that in the past were nebulous and inconsistent in their implementation (e.g., liquefaction mitigation). The manual, especially with the recent updates, also more clearly defined the roles and responsibilities of various WSDOT offices, especially in the context of the WSDOT project management process. Plans for continuing upgrades to the GDM are discussed further below in the proposed accomplishments for 2009.

LRFD Design Specification Implementation for Foundations and Walls

As indicated in previous annual reports, we have actively assisted the AASHTO Bridge Subcommittee and the FHWA to accomplish a rewrite of the foundation design sections in 2004 and 2005, as well as to gain the national acceptance needed in the AASHTO Bridge Subcommittee to get the rewrite approved. We also helped to develop the load and resistance factors used for LRFD foundation and wall design. The load and resistance factors are in effect safety factors, and directly affect how conservative, and therefore how costly, the resulting design will be. Several Geotechnical Division staff have continued to participate on NCHRP panels that have been set up to oversee research on load and resistance factor development for foundations and walls, specifically footing strength limit state design and service limit state design for foundations in general). It is our goal to keep the foundations and walls that we design as economically efficient as possible while providing a consistent level of reliability for the performance of these types of structures.

MSE Retaining Wall Research

Since 1990, WSDOT, with the help of a number of public and private sector funding partners, the University of Washington, and the Royal Military College of Canada, has conducted research on the internal stability of mechanically stabilized earth (MSE) walls. MSE walls are commonly used by WSDOT in situations where fill must be added to the roadway prism for widening of the roadway. Our early experience with these walls, and the experiences of others, has indicated that current design procedures are conservative, especially for geosynthetic reinforced systems. We felt that if we could develop a more accurate procedure for estimating reinforcement loads in these walls, substantial cost savings for WSDOT (and nationally as well) could be obtained.

From this research, a new design method for the internal stability of MSE walls termed the K-Stiffness Method has been developed, as reported in previous Annual Reports. The new method appears to provide the ability to significantly reduce the amount of soil reinforcement required due to the greater accuracy and reliability of the method, with potential significant cost savings for these types of retaining walls. The work has been published in international journals and conferences, and is receiving praise worldwide as a major breakthrough for the design of these types of wall systems. We have begun implementation of the research completed thus far through construction and monitoring of some test walls on SR-18 that have been reported in the 2005 annual report. We have also provided step-by-step design procedures for this new method in the WSDOT GDM.

Electronic Preservation of Geotechnical Design and Construction Files

The paper files that contain geotechnical subsurface data, design, and construction records is in effect a significant and important database of geotechnical information that has cost millions of dollars to produce over the years. This information is used routinely for geotechnical design of projects both by in-house staff and consultants and is a very valuable resource. The preservation of these files electronically is strategic for the department both to protect this significant investment and make access to this information easier for those involved in geotechnical design as well as related fields. The database structure, and the detailed procedures for file organization and the scanning/recording process were developed in 2006. Staff to do this work have been hired, and the scanning equipment has been obtained. Preparation of the files for scanning and the actual scanning of the project files began in January 2007. This work has continued throughout 2007 and 2008.

Pit and Quarry Development Pilot Program

Beginning in the 2007-2009 biennium $100,000 was allocated for a pilot project to identify marginal materials and to identify new sources of better materials for Regions that have state-owned pits and quarries. The focus of this pilot effort was the NE corner of the state and aggregates for HMA, specifically selecting Pend Oreille County in the Eastern Region as the first area to investigate.

During this first year of the project a GIS map for Pend Oreille County was prepared that included locations of the P&Q sites. Geology for the county was added that identified the geologic units for the P&Q sites. All Materials Laboratory testing data for the P&Q sites were scanned, and a table with test results is being developed. A field review of 13 aggregate sites was conducted, and selected geologic units were sampled for laboratory testing. Based on the field review and test results, it was concluded not to pursue alluvial/glacial aggregate pit sites within the valley bottom. These sources tested poorly, were fine-grained with many existing sources depleted. The focus will be on the bedrock sources that tested well, and include USFS quarry sites. A review of the USFS test data in Colville was completed. These data include geologic reports for specific quarries located in the Colville National Forest.

Developing GIS as a Geotechnical Design Tool

The Division began using Geographic Information Systems (GIS) technology and hired a GIS Specialist in October 2006. Since then, GIS has been used extensively to provide mapping, analysis and data management support on geotechnical engineering design projects. GIS supports Division daily operations and contributes to achievement of Materials Laboratory strategic objectives by supporting projects such as Pits and Quarries. This year the Division increased its GIS capabilities with the addition of a new GIS Support Staff position. This was a very productive year in terms of developing a comprehensive understanding of the complex GIS needs of the Division. GIS was instrumental in supporting a variety of projects including: estimation of cable mesh drapery requirements, landslide and debris flow analyses, highway alignment assessments, 3D viewshed analysis, aggregate resource quality mapping, subsurface geologic mapping, borehole navigation mapping, analysis of unstable slopes and analysis of bridge vulnerability to seismic and liquefaction hazards.

The Geotechnical Workbench project to develop spatial data and tools to support GIS mapping and analysis is nearing completion, but is still awaiting final deployment. Standards for data collection and management are also being developed to improve the integrity and availability of geotechnical data and documentation in the future.

A Scope of Work has been developed to support the development of a Geotechnical Database Management System (GDBMS) what will improve the management of geotechnical data and data delivery. The GDBMS establishes strategies for managing geotechnical data, and a key feature will be the ability to spatially locate geotechnical boring logs.

A Scope of Work has been developed to create an application using ArcGIS Server technology to link geotechnical project documents stores in a Stellent ™ database with spatial features in a web-based GIS environment.

Develop Seismic Bridge Foundation Program Needs

The current seismic retrofit program that is part of the P2 program does not really address bridge foundation stabilization needs resulting from liquefaction. This issue not only affects the seismic retrofit program, but also has implications regarding how to address liquefaction stability concerns when widening an existing bridge for capacity or alignment improvements. In 2006, a section was added to the GDM that addresses the process and design standards to use when a bridge needs to be widened and the existing bridge has not been previously stabilized for liquefaction. While that process had been carried out informally in past years to address this issue, and the process defined in the GDM for this issue has been used in a few instances, the process itself could not be effectively implemented. Since that time, an instructional letter IL4074 was issued to provide policy guidance on how to handle this issue. Additional funding will be required to address the programmatic impact of this issue.

LRFD Design Specification Implementation for Foundations and Walls

Continued development of the AASHTO LRFD Bridge Design Specifications regarding foundation and wall design is anticipated in 2009. Specifically, we anticipate sending design specification improvements for pile foundation design to vote, begin implementation of improved shaft design procedures and resistance factors from the FHWA, development of improved specifications for the seismic design of walls, and development of new resistance factors for service limit state design of foundations (i.e., settlement, lateral deformation).

MSE Retaining Wall Research

The research on MSE walls will continue through 2010, providing refinement of the K-Stiffness Method, and broadening its applicability to poorer quality backfill materials as high quality backfill materials continue to become more scarce, and also integrating it with other aspects of MSE wall design (e.g., seismic design, abutment loads, etc.). We will continue to combine our efforts with the Japanese to incorporate their wall data using lower quality fill materials with our own efforts. We hope to take advantage of any new walls constructed using the K-Stiffness method to verify the accuracy of that method. These field design method verification walls are critical to the implementation of this research, as well as the extension of this new method to poorer quality soils and other loading situations such as seismic. We will also continue to work with the AASHTO Bridge Subcommittee to continue the implementation process for this new design method in the AASHTO LRFD design specifications.

Developing GIS as a Geotechnical Design Tool

Once the Geotechnical Workbench is deployed, the development of the GDBMS, and development of web-based and desktop GIS applications this year will continue. Now that the scope of work for developing a statewide GIS database of boring logs has been developed, it is anticipated that the Division will begin populating the boring log database in the coming year. The Geotechnical Division plans to utilize a balanced combination of web-based applications (e.g., ArcGIS Server and ArcIMS), desktop applications (e.g., ArcGIS Desktop and ArcGIS Explorer), and database technology (e.g., SQL and StellentTM) to meet the increased demand for GIS products and services in 2009. GIS will undoubtedly be used for increasingly more complex and sophisticated analysis projects, as well as the development of new products and services. Continued participation in the GIS Advisory Committee, the driving force behind the implementation of GIS throughout the agency, will further establish the Division's position as a key player in the decision making process and allow the Division to influence policies that affect the implementation of GIS at WSDOT.

The speed with which these GIS activities are implemented will depend on funding and availability of staff. The additional GIS staff person added to the Geotechnical Division left to pursue additional education in early 2009, and due to funding constraints, will not be backfilled any time soon. This may drastically slow the Geotechnical Division GIS development efforts.

Update WSDOT Geotechnical Design Manual (GDM)

It is recognized that the GDM needs to remain a living document to keep up to date with the latest developments, but that changes to the manual should not be made frequently. Our goal is to update the manual once per year, unless an urgent need is discovered that warrants correcting sooner. Furthermore, some chapters in the GDM were not fully developed. Updates planned in 2009 include Chapter 8 (foundations) and Chapter 15 (walls), as well as minor changes in several other chapters.

Electronic Preservation of Geotechnical Design and Construction Files

File scanning will continue, but subject to availability of funding.

Pit and Quarry Development Pilot Program

This project will likely be delayed due to budget cuts. However, once funding does become available (which may not occur until after 2009), next steps include sampling and testing of potential bedrock sources, with a focus on specific geologic rock types that have a high potential to produce high quality quarry sources. The information obtained from the USFS will be used to review the quarry sites in the Colville National Forest. A project report with results and recommendations will include aggregate resource maps for the targeted field area. We will work with the Eastern Region Material Engineers Office to plan a strategy for new source investigations and beneficial development of current materials sources.

Pavement Management Performance Measure

Pavement Management Section

Pavement Condition Trend

This performance measure documents the statewide pavement condition as represented by the pavement structural condition (cracking, faulting, patching, etc.), rutting and ride (smoothness) measurements on the state highway network. This measure includes all pavement types, chip seal, asphalt, and concrete. These condition measures are used to characterize each pavement section in to one of five categories: very good, good, fair, poor, and very poor. A pavement section is determined to be "due" for rehabilitation when it has reached the "Fair" category based on one or more condition measures. The chart illustrates the number of lane miles of pavement in each of the five categories from 1996 to 2007 for the approximately 17,500 lanes miles of state route system. WSDOT's goal is to reach approximately 1,700 lane miles of pavement in the "Fair" category and none[1] in the "Poor" or "Very Poor" category. Since last reporting in January 2008, the 2007 condition data (rated and analyzed during 2007-2008) has been added and shows that the poor pavement ("Poor" and "Very Poor" categories) has increased by about 9 lane miles or 0.8 %.

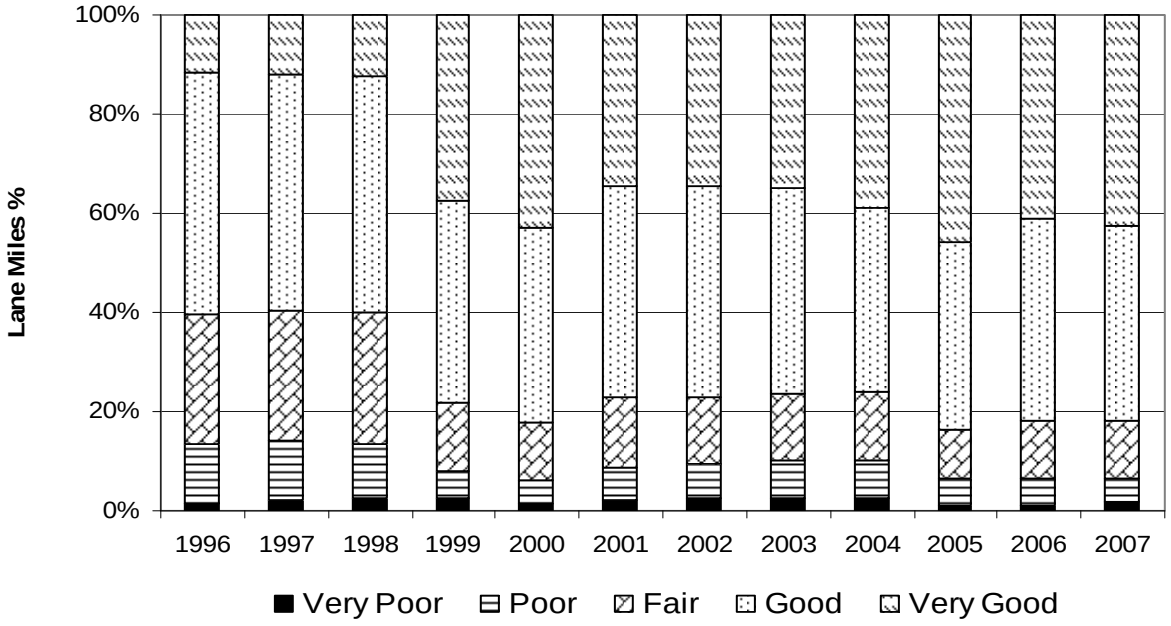


Figure 1: Pavement Condition

The following table represents the above figure and illustrates the number of good (pavements in very good, good and fair condition) and poor (pavements in poor and very poor condition) lane miles for all pavement types.

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Good (lane miles)	15344	15197	15383	16354	16516	16186	16197	15916	15965	16617	16743	16160
Poor (lane miles)	2368	2515	2387	1441	1068	1578	1659	1787	1797	1162	1153	1162

[1] Except for those sections of pavements that are intentionally delayed due to upcoming reconstruction or other major construction work.

QA/QC in Pavement Rating

This performance measure attempts to quantify the accuracy of annual pavement condition survey using statistical methods. One of the concerns WSPMS users have raised in the past has been that, in some cases, the survey results do not accurately reflect the condition of the pavement section. After the rating crew has finished rating a "set" (approximately 100 miles of roadway), about five random sample sections, each approximately 1 mile long, are selected within this set and are rated again ("sample" rating) by a different rater than the one who performed the "production" rating. The Pavement Structural Condition (PSC), a combined index of the various distresses on the pavement surface, is then computed using both the "production" rating and the "sample" rating and are then compared for any statistical differences. For the 2007-2008 pavement rating, 504 sample sections (each approximately 1 mile long) out of a total of approximately 8,600 miles of rated roadway were considered. The "production" and "sample" ratings were tested for differences using paired t-test and Wilcoxon signed rank test and both tests indicated that there are no significant differences between the two ratings.

The following two figures show graphically the differences between the "production" and "sample" rating. Out of the 504 sample sections considered, 487 sections (97%) had a PSC difference of less than 10 points and 17 sections (3%) had a PSC difference of more 10 than points. In Figure 2, the solid line represents the line of equality (R-squared = 91.3%) and the dashed lines represent ±10 PSC points difference.

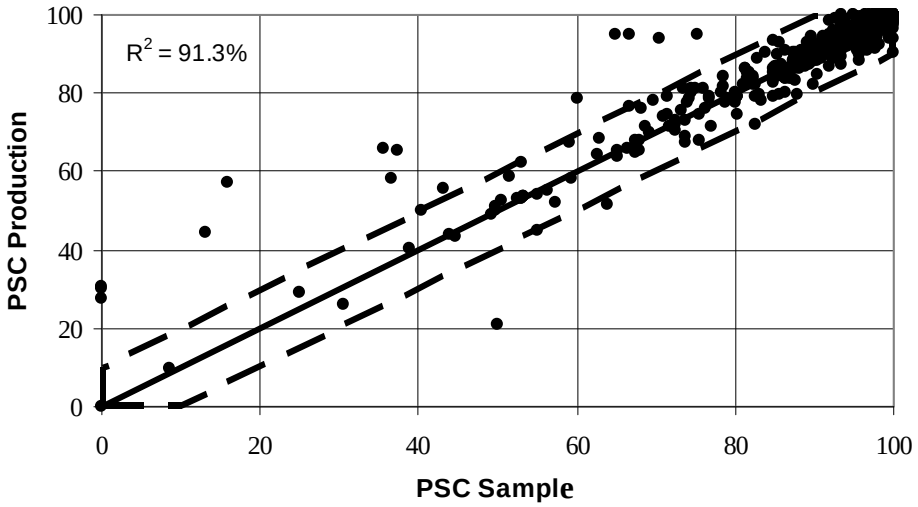


Figure 2: PSC Comparison

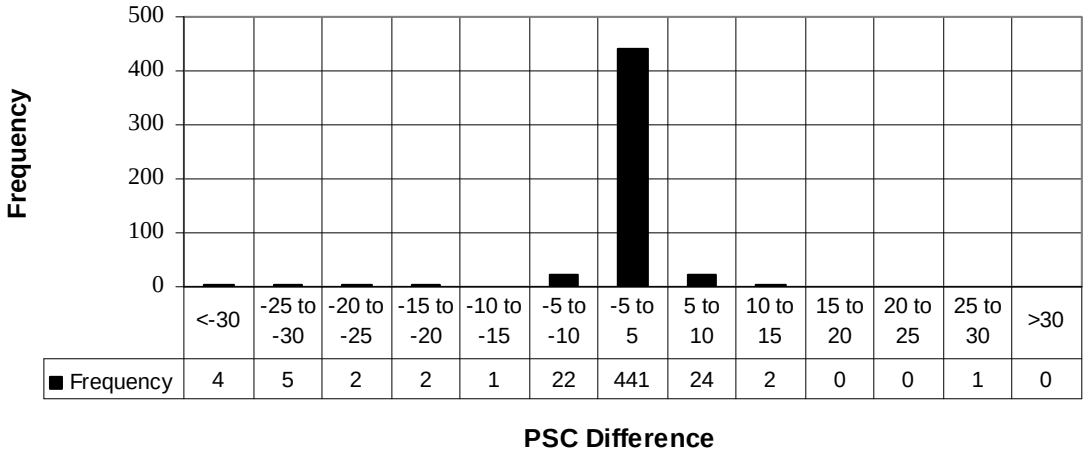


Figure 3: Histogram of Differences in PSC between Production and Sample Rating

Pavement Design

Pavements –Review of Region Pavement Rehabilitation Reports

This performance measure documents the number of days to review, analyze, and concur with Region Rehabilitation Reports. This measure accounts for the time the Region Rehabilitation Report is received at the Headquarters Materials Laboratory until the time that the concurrence letter is completed and sent to the Region. The target for rehabilitation report concurrence is 20 days. Twenty days was set as a target for 2007 and again in 2008. The average time required to review rehabilitation reports for 2007 was 3 days. The average time required to review rehabilitation reports for 2008 was 6 days. On occasion, the target of 20 days was exceeded, however, this was often the result of obtaining addition information from the Region or other data needed to review the reports.

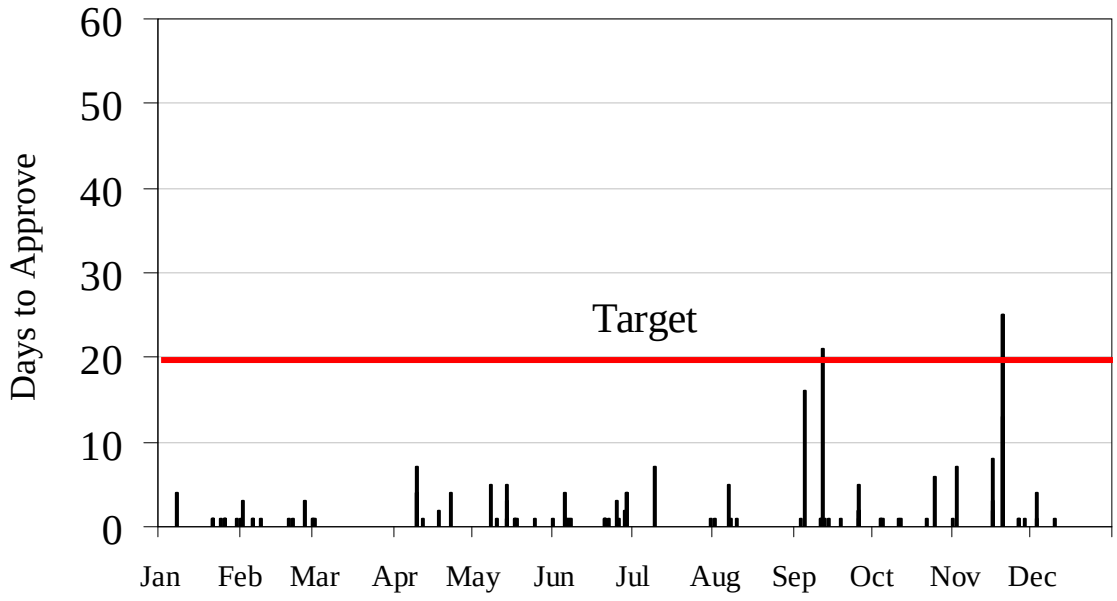


Figure 1. Days Required to Review Pavement Rehabilitation Reports for 2007.

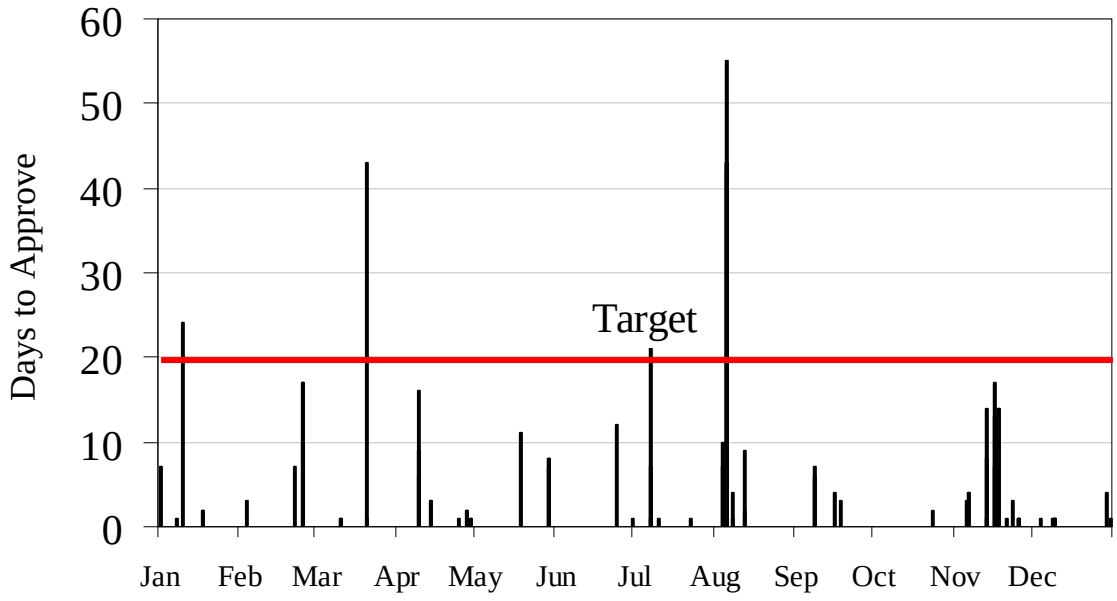


Figure 2. Days Required to Review Pavement Rehabilitation Reports for 2008.

Administrative Performance Measures

Information Technology Support Performance Measure

IT Support – Help Desk Response Time

The Materials Laboratory IT Support categorize requests according to the following five major areas: Workstation (hardware, software, etc); Printing (copier, printer, label maker, etc.); Network (hardware, software, etc.); Services (data backup, internet or intranet, loaner, research and development, etc.); Account Services (domain, e-mail, RAS, etc.).

The following graphs illustrate the average completion time for all IT help requests in the five mentioned categories. Categories, such as development, are not included in this performance measure since the Materials Laboratory IT Support does not have direct control over this function. In addition, the analysis has excluded all requests that require the acquisition of either hardware or software, since in many cases this may require several days to several weeks for the acquisition and shipment.

Total Requests in 2008 – 3012